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DANGERS OF GAS LIGHTING.

THE record for the year 1886 of accidents arising from the use of gas is, we are inclined to think, abnormally gruesome. Destruction of property, personal injury, and, in an appallingly large number of instances, fatality itself have attended the employment of the familiar medium of illumination. Its very familiarity seems to constitute an element of danger, for the reason that people are more careless than they would be with a source of light with the attributes and characteristics of which they were only slightly acquainted. So wide, too, has become its use, and so much a matter of course in the modern household, that the less important of the accidents which have been so common latterly have passed without much comment and without arousing in the public mind any appreciable degree of apprehension as to the safety of gas lighting. The crushing calamity which has marked the opening of the new year at Portsmouth will perhaps be more effective in drawing attention to the unsatisfactory conditions which prevail in modern gas illumination. That a defective fitting or weak pipe may, if neglected, lead to an escape of gas which may have unpleasant consequences is of course generally known; but comparatively few people, we imagine, regard their gas installations with the vigilance which would seem to be called for by the fact that a bad spot anywhere may at any moment precipitate a house into ruins and a household into mourning. This is the point of difficulty with gas lighting. We have little to say, broadly speaking, against gas as a means of illumination, for it has been a very faithful servant in the past, and will continue to be largely used for a long period yet, no matter what developments may await its rival, the electric light. But we do say that very much more care than is ordinarily exercised is required in its management in indoor installations; very much more care and supervision, we would go so far as to say, than is required, on considerations of safety to life, for electric lighting installations.

An obvious suggestion to the mind by the lamentable occurrence at Portsmouth is whether it is not advisable on the part of the authorities to supplant gas in public buildings generally, including such places as the demolished barracks, by its safer and more efficient substitute. Our military readers doubtless have opinions as to whether or not it would be a satisfactory plan to employ soldiers in the erection and maintenance of electric light installations where such installations are to be utilised for military purposes. The training of the ordinary red-coat, it occurs to us, to the proper management of the electric light, incandescent or arc, should be a very simple matter, and we hope to see the experiment made. Meanwhile, if any of our readers entertain definite ideas upon the subject, we shall be glad to give them publicity.

ELECTRO-METAL EXTRACTING.

IN the REVIEW for June 25th, 1886, we made mention of the formation of a company organised for working certain patents, covering the processes of extracting, refining, and plating metals by means of electricity. One of the principle features of the undertaking was extracting the tin from the surface of waste tin scrap, leaving behind the iron base which was calculated to possess sufficient value to cover the entire cost of working expenses, thus enabling the returns from the sale of tin to be considered as pure profit. On the date above mentioned, we showed that the process was not by any means new, and that some 10 years previously, electro-extracting carried out on a large scale, had proved a failure. Notwithstanding this, we did not see that the new venture should necessarily be doomed to share the same fate, and we pointed out that by means of improved plant and better methods of working, there appeared to be no reason why success should not be assured. Apparently the Electro-Metal Extracting, Refining and Plating Company, Limited, thinks that this happy state of things has been secured, and in consequence thereof we notice that, as the prospectus has it, the very remunerative results of the process has decided the directors to extend the company's operations, and for that purpose they offer the remaining preferred shares of the company for subscription. We suppose that the directors have good reasons for proposing an extension of their business, but these do not appear from a perusal of the prospectus. They seem to have arrived at a decision, whether judicious or otherwise time will show, from a semi-laboratory experiment made by Messrs. Mackenzie and Brougham, lasting 44 minutes, and from a number of business enquiries, together with a few favourable expressions of opinion upon samples of the company's productions. Considering that the company has now been engaged in its operations for more than six months, it is not a little surprising that something of a more definite and practical nature than the foregoing should not be offered as an inducement to would-be shareholders. But, although the arguments urged in the prospectus are of the most shallow nature, we have no doubt ourselves as to the ultimate success of extracting, refining, and plating by electricity. That there is room for extensive developments of the processes owned by the company is evident, but in order to create the demand the fact must be brought forcibly home to the public. Would it not then have been better by far if the directors could have shown a profit for a half year's work?

Electric Locomotion.—Mr. A. Reckenzaun will read a paper on this subject before the Society of Arts on February 2nd.

TELEPHONE LEGISLATION IN SPAIN.

UNTIL lately, the telephone system throughout Spain has been exclusively in the hands of the Government, for it was expected that a considerable addition to the revenues of the State would be thus obtained, and it was feared that by placing this means of communication in the hands of private individuals or companies the organisation of plots against the Government might be facilitated. Experience has, however, shown that notwithstanding all efforts on the part of the Government by increasing the telephone system, improving the service and lowering the rates, a serious loss has resulted, which has increased in amount with the opening of every fresh office. The dangers of a political nature, so much dreaded, so much exaggerated, have at last been regarded with a clearer-sighted policy, and the conclusion arrived at that more liberal views would better serve the interests of the State. Private efforts, stimulated by competition, would succeed in the development and improvement of an industry which, if administered by the State, would never rise beyond mediocrity. The Spanish Government has consequently decided to give concessions to private individuals or companies for the establishing and working of telephone lines. The concessions will be sold by public auction, and will be granted to the bidder who offers the Government the highest percentage on the gross receipts, the lowest offer to be fixed at 10 per cent. The concessions will be given for a term of 20 years, and will carry with them no exclusive privilege or monopoly. On the lapse of this term the lines become the property of the Government, the instruments, however, remaining the property of the concessionaire. The Government has the right to make any inspection it may think necessary, and has the power to suspend the service at any moment. Full details of the conditions are published in the Berne *Journal Télégraphique* of the 25th December, 1886.

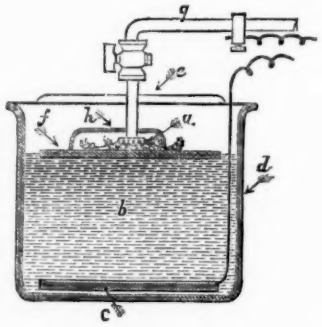
A THERMO-ELECTRO-CHEMICAL REGENERATIVE BATTERY.

A NUMBER of articles have lately appeared in the ELECTRICAL REVIEW on the subject of certain electrolytic experiments which bear a close relation to some that the writer was engaged in making a few months ago, and since attention has been drawn in this direction, a few particulars of my results may be of interest to your readers.

The principal passages alluded to are those of Prof. Bouty on "Thermo-electric and Electro-thermic phenomena at contact of metal and liquid," in the issue for the 3rd December last; one or two allusions in another paper by Prof. Bouty on "Electrolytic Conductivity," in the issue for the 10th December, 1886; and also the article "On the temperature coefficient of Clark's Standard Cell," by Mr. Dearlove, in the same number. Many other investigators have been at work in this field, amongst whom must be mentioned Gladstone and Tribe, and Gore. The latter has considered the subject in considerable detail, and in one of his papers he states that the development of electromotive force between temperature differences in the case of metals in contact with liquids may be due to three causes: 1. Thermo-electric action pure and simple; 2. Thermo-electro-chemical action; 3. A combination of both these actions. Under the second of these causes, viz., thermo-electro-chemical action, a large variety of chemical reactions may occur, and the idea conveyed is a little vague, for it would include reactions of widely different character. It is the writer's wish to draw attention to one of these reactions of a very definite and beautiful nature to which his experiments had reference.

The above title accurately, although somewhat sensationally, describes an arrangement which he has devised to illustrate the thermo-electro-chemical phenomena under consideration. It will be better to pass over the various stages of development the apparatus has passed through and describe only the latest and most practical form.

This consists simply of a beaker or other suitable vessel which possesses a flat bottom, filled with a saturated solution of copper sulphate. At the bottom of the beaker rests the cathode or cold electrode, which consists of a disc of copper to which is attached a well-insulated terminal wire leading up through the liquid to the open air. It is well to surround this wire with a glass tube so as to prevent circulation of the heated and cold liquid. A second disc of copper, which forms the anode, is suspended on the surface of the liquid by means of a copper tube fixed to its centre, which may be supported in any convenient manner. The tube is perforated radially by small holes near the disc, so that on connecting the other end to a gas pipe, a rose burner is formed which readily heats the disc when the gas is lighted. Advantage is also taken of Mr. Fletcher's recent improvements in heating water by conduction, for which purpose short pieces of copper wire are riveted round the disc half-way between the centre and the circumference, the free ends reaching into each small jet of gas. It is as well to have a second disc fixed above the burner so as to radiate additional heat downward, and some projecting wires fixed to this latter disc will act as an excellent support for the upper electrode by resting on the edge of the vessel. A glance at the sketch will show clearly the arrangement.



d = glass vessel.
c = cold copper disc or cathode.
b = copper sulphate solution.
f = hot copper disc or anode.
a = rose gas burner.
h = copper conductors of heat.
e = upper disc to radiate heat downwards.
g = gas pipe.

Almost immediately after the gas is lighted (of which, by the way, a very small quantity is required) the upper disc becomes heated and electromotive force is set up between the heated and cold electrodes on closing the circuit. But it is the extreme beauty of the reaction in this case that is especially interesting and to which attention is invited, viz., that copper is dissolved off the heated electrode and deposited on the cold metal. The reaction is therefore precisely similar to what goes on in an ordinary copper electro-plating bath; but the energy which sets it in motion is ordinary heat, or, more accurately, differences of temperature, instead of an electric current. It is interesting here to reflect that under these conditions we have an instance of the dissociation of a metallic salt under the influence of what are practically ordinary temperatures. The reaction occurs in like manner with a solution of copper nitrate, but not satisfactorily with any other salt of copper which has been tried.

It is possible that the development of E.M.F. which Mr. Dearlove obtained in his experiment with heated and cold electrodes of zinc in a solution of zinc sulphate is due to a similar reaction.

It is a curious fact, that in the case of the thermo-

current the reaction is almost completely stopped by the addition of even a very small quantity of sulphuric acid, which does not interfere with, but, on the contrary, rather improves the deposition by the electric current. This is probably due to some local cause, such as the production of SO_2 on the heated metal, which may produce an opposing E.M.F. and so stop the effect. At one time it was thought that the development of maximum E.M.F. would result from the use of an electrode which would be most readily attacked by the heated solution and most stable in the cold, on the same principle as the ordinary voltaic cell, and there may still be something in the idea in some cases, but other actions are liable to interfere, as in the case cited. In further illustration of what a wide field comes under the title of thermo-electro-chemical action, it may be stated that a somewhat higher E.M.F. is obtained by substituting copper sulphate with dilute hydrochloric acid, but the action in this case is not at all the same, there being no indication of transference of metal, and the current is not constant as is the case with the copper sulphate solution, which would tend to show that the action does not come under the first cause, viz., simple thermo electricity.

From what has been stated it is conceivable, perhaps, rather than practicable, that a battery on this principle might be made regenerative by arranging to apply heat alternately to one or other electrode and thereby maintain an equality of thickness of the metal plates, as it will be seen that the current is due to heat, and heat only, and in no way due to the consumption of chemicals. The E.M.F., however, is rather diminutive, and the action proportionately small. Were it greater it would no doubt be commercially valuable, for by suitably arranging for the economy of heat from loss by radiation on the principle of the Norwegian cooking box, and taking advantage of the physical fact of the inappreciable conductivity of liquids for heat, there would be hopes of considerable economy and of consequent conversion of heat into electric energy compared with the metallic forms of thermo batteries. A further point in its favour, if arranged in a horizontal position, is, that the solution would keep uniformly dense all the time the action was going on, as the lower stratum of solution as it became denuded of the copper salt would have a fresh supply pouring upon it from above.

But the most important feature of the reaction is the wonderfully constant E.M.F. produced. During the experiments a Post Office galvanometer of 1,278 ohms was used to indicate the current, and, as was expected, the E.M.F. rose with the increased difference of temperature to a maximum at 100° C. It is probable that with a higher temperature under pressure the E.M.F. would continue to increase. But at 100° C. the E.M.F. remains constant as long as the cathode remains cold. The electrodes may be externally short circuited for hours, but on interrupting this circuit and introducing the galvanometer, the deflection will be just as at the commencement provided the temperatures are the same. This fact would have been more important had it been practicable to generate a larger quantity of electric energy by its means, but it is suggested that in a less pretentious way it may still have a field for use, viz., as a standard of electromotive force which is practically a difficult matter to obtain. From this point of view the apparatus possesses many advantages, the principal ones being that the necessary differences of temperature, viz., 100° C. and zero C., can be readily obtained and with almost absolute constancy, and that the materials, viz., copper, copper sulphate and water, may be procured in a state of great purity.

It is with great regret that the writer has been able to devote but little time and thought to this subject, particularly with reference to this latter suggestion, which naturally requires patient research to work it out properly.

The writer wishes to express his thanks to the board of the A. A. Brush Electric Light Company for the facilities afforded him in carrying out his experiment at their electric light works.

LEGH S. POWELL.

DOCTOR AUER'S INCANDESCENCE BURNER.

DR. AUER'S gas lamp is based upon the incandescence of certain metallic salts placed in the middle of the flame of a Bunsen burner. The principle is not a new one; it is that of the Clamond lamps, in which, it will be remembered, the incandescent material consists of a small cube of magnesia. The arrangement of the Auer burner is, however, very simple, and in this respect it seems to possess great advantages. It consists of an ordinary Bunsen burner, the end of which is capped with a cowl of woollen or cotton material which has been specially prepared. This cowl, which is six or seven centimetres in length, is slightly truncated in shape; it is supported by means of a platinum wire which passes through its upper extremity and is fixed to two iron rods united at the top into a ring. The longer of these rods is fixed by a screw to a ring supported by the stem of the burner.

When the burner is lighted a considerable amount of heat is generated in the cowl, which in a few seconds constitutes a focus of bluish white light remarkable for its steadiness and brilliancy.

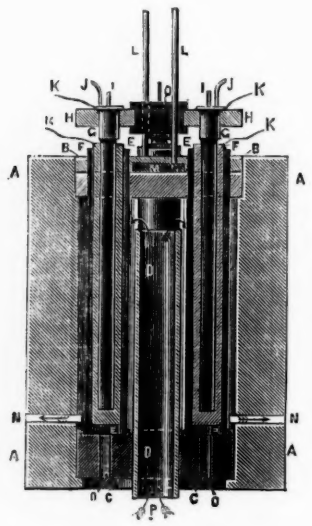
As to the manufacture of the incandescent cowl we have as yet no complete information, says M. Ph. Delahaye writing to *La Nature* of the 18th inst., but these are the terms in which Dr. Auer's patent is expressed as regards this point:—"We take a solution of zirconia and nitrate or acetate of lanthane or of yttrium and with this the woollen or cotton material forming the cowl is impregnated; this material is then carbonised and leaves a kind of net-work which is applied to the extremity of the Bunsen burner. This net-work seems more favourable to the production of the light than the solid cylinders of zirconia tried in 1868 by Tessié in oxyhydrogen burners."

According to the inventor each cowl costs about one kreuzer (2·5 centimes), and can give light for 1,000 hours, until it becomes so encrusted as to diminish its lighting power. With equal lighting power, the consumption of gas in the Auer burner would be half that of ordinary batswing burners; thus there would be

a saving of 50 per cent., but this estimate requires to be verified. The duration of the cowl ought also to be determined by exact experiments.

THE KENDALL HEAT BATTERY.

THIS apparatus consists of two metallic plates, tubes, or boxes, with a saline or vitrified substance, called the "medium," between them. One metallic plate or tube is exposed to the hydrogen or a mixture of gases containing free hydrogen, the other metallic surface being exposed to heated air or oxygen. The inner tube is supplied in its interior with the hydrogen, and the exterior tube is exposed to heated air in a flue, so that the entire structure is kept at a red heat. Platinum has thus far been found to give the best results, though other metals can be employed, such as palladium, gold, iron, &c., since all of these metals are pervious to hydrogen at a red heat. In the same way the "medium" between the plates or tubes admits of a considerable variety, as almost any vitreous material not having a corrosive action on the metals can be used; or clay or earthenware saturated with chloride of sodium, or potassium; or a porous refractory material —such as earthenware or fire-brick permeated with vitreous matters.



The latest form of battery adopted by the inventor, Mr. James Alfred Kendall, is shown in the accompanying illustration (taken, together with the description, from the *Electrical World*), which represents a longitudinal section of a cylindrical furnace for a battery of four cells arranged in a circle, the section being through the centres of two cells and through the centre of the group and apparatus generally.

The wall of the furnace, A, of fire-brick has a fire-clay top disc, B, with holes for the cells. The heat from the fire, which may consist of gas jets or a furnace, passes at P up into the tube, D, and strikes the porcelain tubes, E. The outer platinum tubes, F, are corrugated longitudinally, and the inner platinum tubes, G, are suspended from an earthenware disc, H. The latter is provided with a metal plug, Q, which can be slid up and down the iron rods, L, L, and adjusted at any height by a screw.

The hydrogen gas is conveyed to the bottom of the cells by the tubes, I, I, the waste of gas making its exit by the tubes, J, J. The conductors, K, K, are attached respectively to the inner and outer platinum tubes. The heating gases from the furnace make their exit at N, after circulating around the tubes, and the holes, O, allow the atmospheric air to come in contact with the outer platinum tubes.

It will be understood that the vitreous or saline material described above and employed as the "medium" between the platinum tubes is added either in the liquid state or is fused in place by submitting it to intense heat. The porcelain tube, E, is employed simply for the purpose of protecting the cells and equalising the heat, and also of preventing the furnace gases from adulterating the air supplied to the outer surface of the outer platinum tube. The production of electricity, as will be seen, depends upon the continuous absorption of hydrogen by the inner platinum tube and its passage through the medium and the other outer tube to the oxygen on the outer surface of the latter, where a combination between the two gases takes place. The "medium," though normally not a good conductor, becomes conductive by the presence of the high heat and by the passage of the hydrogen.

The inventor claims that the passage of the hydrogen does not involve the decomposition of the medium used. "Whether the action is electrolytic—viz., by the aid of minute quantities of water in the red-hot glass, &c.," he says, "is not known, and might be very difficult to ascertain; but whether we assume the presence of water or not, the fact remains that currents of electricity of considerable power can be produced in this way."

THE BERNSTEIN ELECTRIC LAMP.

AN exhibition of recent improvements effected by Mr. Bernstein in his system of electric lighting by low resistance incandescence lamps, was given on Monday last at the works of the Bernstein Electric Lamp Company. The exhibition was viewed by the members of the council of the Society of Telegraph-Engineers and Electricians, and by members of the scientific press.

Mr. Bernstein reminded those present that some months ago he had brought before the notice of the Society of Telegraph-Engineers and Electricians a full description of his low resistance incandescence lamp, together with details of the various appliances which had been designed in connection with the same. Since that time he had been constantly at work improving the system, and, as he would show, he had attained a great measure of success. As regards the conductors to be used there was nothing in these that need be referred to. With reference to dynamos he would state that in cases where the number of lamps to be used in a circuit required an electromotive force of 2,000 volts to be used, it was better to employ two 1,000 volt machines than one of 2,000 volts, as not only was the price of the two 1,000 volt machines together less than that of a single 2,000 volt machine, but it was much easier to maintain the insulation of the former than of the latter. The recent decision in the Edison-Woodhouse and Rawson case had stopped the use of the "flashing" process in the manufacture of lamps, but this difficulty he had succeeded in getting over. It had been insisted upon that the use of the somewhat complicated "cut-out" which he had devised for preventing the breaking of the carbon in a lamp breaking down the circuit would be a very serious hindrance to the development of his system; he had therefore tried hard to devise some method of getting over the difficulty, and in this he was glad to say he had completely succeeded. The arrangement he had devised consisted of a shunt fixed to each lamp, which was formed of a mixture of oxide of mercury and powdered carbon placed between two metal conductors. This shunt was adjusted to a resistance of about 500 ohms, and as very little current passed through it the resistance remained unchanged; immediately, however, that the carbon of the lamp broke, the current through the shunt became greatly increased, and the result was that the semi-metallic mixture broke down as it were and became perfectly conducting, thus keeping up the continuity

of the circuit. Some practical experiments which Mr. Bernstein made demonstrated that this action of the new shunt was all that could be desired.

These shunts could be made at a very small expense, and when fused could be replaced at a mere nominal cost. In practice the shunts or "fuses" were placed within the lamp switch, the latter being ingeniously arranged so that the withdrawal of a fuse when the lamp was not in use did not interrupt the circuit; the fuse also could not be withdrawn when the switch was turned to the position at which the lamp was short circuited, so that practically all probable contingencies which would cause a breakdown were provided against.

An installation of the lamps had been fitted up at some Alkali Works at Northwich, and had been at work for two and-a-half months, the lamps being kept burning from 4 in the afternoon till 8 in the morning, or a total period of 1,000 hours. No blackening of the globes was observable, and the resistance of the lamps had changed but very slightly. The question of suitable fittings for the lamps had been got over, those which had been designed being elegant in appearance. Altogether the low resistance lamp showed promise of a very satisfactory future, and we shall return again to the subject in our next issue.

A NOVEL REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

IT is usually considered wise to prevent as much as possible the heating of circuits and regulating apparatus employed in electric lighting, but, according to the *Electrical World*, this very heating effect has recently been employed by Prof. Elihu Thomson to effect the regulation of dynamos.

It is well known that with metals generally the electrical resistance increases with an increase in temperature, and this is the property which is employed by Prof. Thomson to obtain a gradual regulation of the current, or more particularly to maintain a constant electromotive force on shunt-wound and compound incandescent machines.

Before entering into the details of the apparatus employed, it may be well to premise that there are four distinct parts which come into operation to effect the desired regulation; these consist of, first, a "controller" magnet connected to the circuit so as to be sensitive to changes in its electrical condition; second, a "motor" device which is governed in its action by the controller magnet; third, a variable resistance connected to the dynamo in such a way as to control the generating capacity of the same, and composed of a material whose resistance varies with the changes of temperature; and, fourth, apparatus for governing the temperature of the resistance coil.

The accompanying illustration, fig. 1, shows the manner in which the above conditions are carried out. As will be seen, the field coils are placed in shunt to the work, and in the shunt is included the resistance, R, composed of platinum or iron, and forming a considerable fraction of the total resistance of the shunt. The resistance, R, is enclosed in a tube or chimney, lined with a non-conductor of heat, and having holes at the bottom for the entrance of air.

The opening at the top of the chimney is controlled by a valve, V, at the end of the lever, L', carrying the armature of the magnet, M. The valve controls the draft of air through the chimney, T, produced by the heat developed in the coil, R, and, according to the draft, determines the temperature that the coil shall attain by the agency of the heating effects of current passing through it.

The magnet, M, is energised from the mains, *a*, *b*, and its circuit is controlled by contacts operated by the controller magnet, C. The controller contacts consist of a stop, D, and a contact screw, S, made adjustable and mounted on the lever, L, which carries the armature, N, of the electro-magnet, C. The contact, D, is connected to one of the mains, *a*, and the contact, S, is connected through the electro-magnet, M, with the other main, *b*. In addition, there is a condenser, G, for preventing sparking at the contact, D, on the opening of the circuit of the magnet. The electro-magnet, C, is also connected in one of the branches, between the mains, *a*, *b*, so that it will feel any changes in the conditions of potential between the mains, *a*, *b*.

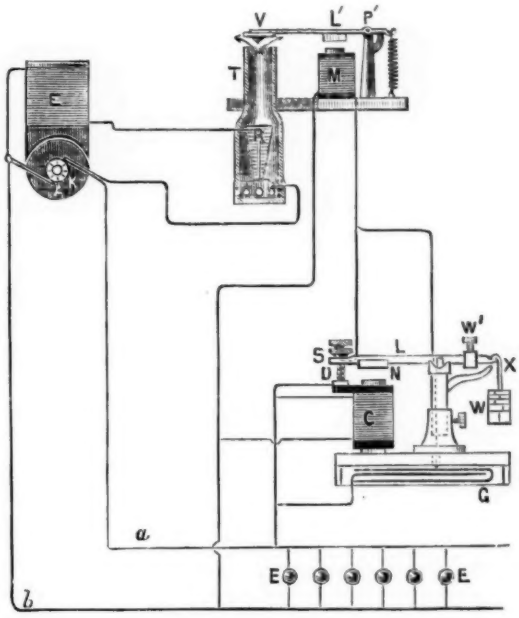


FIG. 1.

The armature lever, L, is mounted on knife-edge bearings, and the pull of the magnet is counterbalanced by a variable weight, W, which is hung so as to avoid friction on the bearings of the lever, and which is preferable to a retractile spring on account of its constancy. A rider-weight, W', is also provided, which can be moved to effect small adjustments of counterpoise.

FIG. 2.

Assuming an adjustment to be made so that there will be a balance when the electro-magnet, C, is energised to normal amount, and that the screw, S, is set so as to act in conjunction with the back stop, X, of the lever to permit a small play at the controller contacts, it will be evident that any very slight variation in the difference of potential between the mains, *a*, *b*, will cause an increase or decrease of power of the magnet, C, which will be attended by a closing or opening of the contact at D. By the action of the controller contacts, D, S, the magnet, M, is thrown into or out of action, and from this there results a change in resistance through a closing or opening of the valve, V, with a consequent heating or cooling of the resistance, R, as the cooling draft of air is cut off or re-established by the operation of the valve.

An increase in the temperature of the resistance, R,

produced by closing the valve, results in introducing greater resistance to the flow of current in the field circuit, including coils, F, and therefore diminishes the power of the field magnet of the machine, while conversely the lowering of the temperature R through the establishment of the cooling air draft results in greater power of the field magnet. These changes in the field magnet change the generating capacity of the machine and the difference of potential between the two mains, *a*, *b*. In practice, there is a vibration of the parts, resulting in the maintaining of such a temperature in the coil, R, through vibration of the valve as to secure a constant electromotive force, or a constant difference of potential between the mains, *a*, *b*.

While employment is made of platinum or iron coils as the medium of action, it is obvious that carbon resistances could also be used, but in this case the action of the valve, V, would have to be reversed since carbon *decreases* in resistances with an increase of temperature. The resistance, R, which is shown in fig. 2, is mounted on a tapering frame so that its successive turns will be displayed laterally and will not shield one another from the current. The frame is constructed of tapering wings, formed of a non-conductor—such as mica—and supported at their inner edges in a metal or plaster stem. At the outer edges of the wings suitable notches are cut for the reception of the iron or platinum wire making up the coil.

THE MONTAUD ACCUMULATOR.

THIS accumulator is of the Planté type, and is modified so as to obtain a more rapid formation, a larger surface, and a symmetrical distance of the plates from each other.

If into an alkaline bath saturated with litharge (added in excess) we plunge two lead electrodes and pass in a current of suitable tension and intensity, there is deposited upon the anode a layer of peroxide of lead varying in thickness with the intensity of the current, and more or less rich in oxygen, according to the intensity of the bath, whilst the cathode is covered with a stratum of reduced lead. The liquid of the bath supplies material for both deposits, whilst in galvanoplastic operations the anode supplies it to the cathode. The principle of the formation consists in introducing in an efficacious manner currents of a great intensity, and thus abridging its duration.

Of two plates thus treated, the one becomes positive, and is covered with a thick layer of peroxide of lead. On leaving the bath it undergoes various preparations and several washings, and is then fit to be mounted along with others to form an accumulator ready to be charged and to work.

The second, or negative plate, is covered with a thick sponge of lead. It is carefully washed, preserved in water with exclusion of air, and submitted to a very considerable pressure. After this operation it presents the appearance of ordinary sheet lead, but though the physical porosity has disappeared, the chemical porosity is intact, and this alone comes into play in accumulators.

When a negative plate is constructed in this manner it is ready to be combined with the positives to form an accumulator.

The inventor has sometimes put into the bath at the positive pole negative plates prepared as just described. They become very easily peroxidised, but they have the grave defect of requiring two preparations in place of one.

To secure an accumulator against any leakage from plate to plate, the solderings and the entire plates must be submerged in the liquid, so that nothing projects up out of the acidulated water except two strong rods for making contact. These rods are covered with an insulating varnish from their origin to above the point where they issue from the liquid.

The plates are of a rectangular form (fig. 1); they are sloped out at one corner, and as two plates in juxtaposition are cut together, when they are separated the sloping out of the one serves for the handle of the other. This handle is doubled back on the plate which is suspended in the bath, so that the part which has to be soldered does not undergo any preparation.

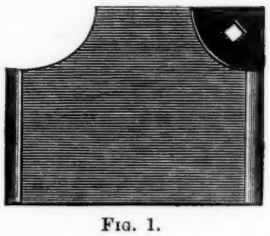


FIG. 1.

A hole pierced in this corner of the plate serves to receive a square rod of lead which connects the plates together and supports one of the poles or contacts of the accumulator.

At the point of soldering the doubled-down handle gives a double thickness, and the margins of the plate are folded in such a manner as to ensure their solidity.

The sloped-out corner affords the free space necessary for the rod of the opposite pole, and one and the same plate may be indifferently connected either to the + or the − at the right or the left.

The plates are made of four different sizes:—No. 1, 19 of which serve for an accumulator of 1 square metre; No. 2, 21, 25 or 29 of which serve for accumulators of 2, 3 and 4 square metres; No. 3, which with 21, 25 or 29 plates composes accumulators of 5, 6 and 7 square metres; and No. 4, which with 21, 23, 25, 27 or 29 plates form accumulators of 8, 9, 10, 11 and 12 square metres.

As the plates are entirely submerged in the liquid their entire surface is active, and, the entire surface being absolutely flat, it is sufficient to preserve their respective distance at any one point in order to have it everywhere alike.

The weight of the plate depends on the intended duration of the plate and its capacity.

As for the negative plate its thickness is the most important factor of its capacity; the proportion has yet to be established for daily practice.

The inventor uses in practice positive plates of 0·002 metre in thickness.

On the other hand, the negative plates have a body of only 0·001 metre in thickness, their greater thickness being due only to the deposit of compressed lead.

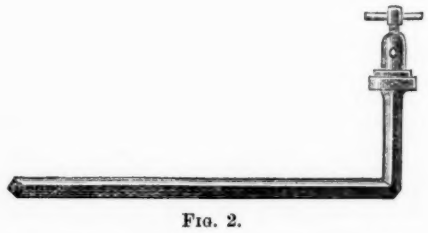


FIG. 2.

The rod which fixes the plates to each pole (fig. 2) is formed of a special alloy of lead and antimony, not attacked by acid. This gives rigidity to the rod and hinders it from binding when the accumulator is taken out of its case. The copper piece which surmounts it is fitted at its base with an iron cramp which is fixed in the lead, and above which is a wide furrow with two grooved parts, which being immersed in the lead hinders the copper from slipping round under the action of the screw.

The rod is square and is cast in a single piece. Against one of its surfaces the ends of the connected plates press flatly up; a square form has been selected to give more surface for soldering.

This soldering is autogenous (as in the lead chambers at vitriol works).

The soldering, as well as the entire plates is entirely immersed in the liquid, and to prevent any leakage, an insulating varnish, perfectly proof against the acid and the current, is laid over the rod from the part soldered upwards.

If it is wished to lift the accumulator from its chest for any verification, hooks passing between the plates, seize hold of the rods and, thanks to the rigidity of the antimony-lead, they effect the removal of the apparatus without bending the rods in the least.

All the parts of the plates must be kept at exactly the same reciprocal distance. The chemical action takes place inversely as the square of the distances, and a difference of only 0·001 metre between two points is sufficient to affect the yield considerably.

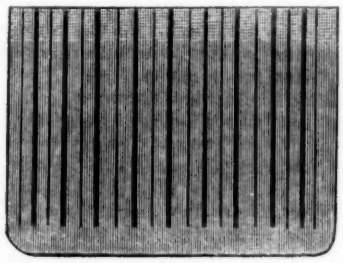


FIG. 3.

For an insulating material, wood, when plunged in dilute acid, is preferred by the inventor. He makes a comb of wood, the teeth of which vary according to the thickness of the plates to be lodged between them. Fig. 3 represents a comb having $\frac{1}{10}$ths of a millimetre for the negative plates and $\frac{2}{10}$ths for the positive plates.

This appliance, which is 0·01 metre in thickness and 0·02 metre in width in the back, is made very cheaply by machinery.

The weight of the accumulator bears entirely upon the back of the combs, which are all placed back downwards, and the number of which varies according to the size of the plates.

Small combs of wood clasp the plates at their extremities, and make the entire accumulator quite compact and manageable.

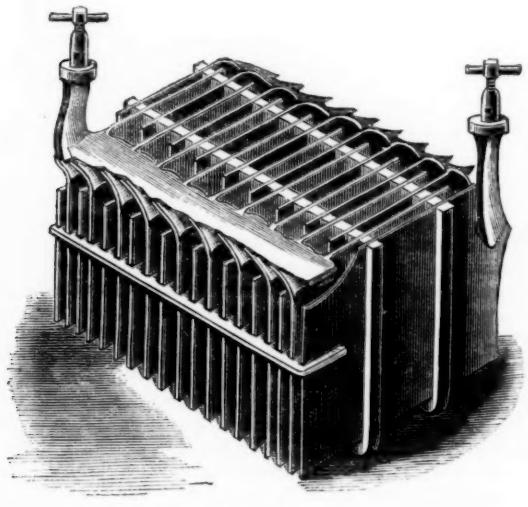


FIG. 4.

The entire accumulator is shut up in a wooden chest, which the outer teeth of the comb serve to insulate from the leaden chest, and to prevent any loss of electricity along the sides.

Fig. 4 shows the arrangement of the side-combs. A single glance at this figure shows that it would be difficult to have more surface without having recourse to curved undulated or folded plates, in which the distances are variable, and consequently defective.

In the Montaud accumulator the weight is simply proportional to the intended duration.

For the notion "so much capacity and so much yield per kilo" Montaud substitutes the notion "so much capacity or yield per square metre, the weight not being taken into consideration."

These Montaud accumulators are classified as follows: they have from 1 to 12 square metres of surface, and the number corresponding to the surface indicates its weight of useful lead, its manner of charging, its capacity and its manner of discharge.

According to the inventor's experiments the square metre of active surface can receive a charging current of 10 ampères, and furnish on discharging a current of the intensity of 20 ampères.

For a "No. 10" accumulator we have an active surface of 10 square metres, a charging current of 100 ampères, and on discharging a current of 200 ampères.

A square metre of lead of the thickness of 0·001 metre weighs about 11 kilos. As both surfaces of the lead are utilised their weight is reduced to 5½ kilos. A No. 10 therefore requires 55 kilos. of useful lead.

It will be seen that to increase the thickness of the sheet of lead merely augments the duration of the accumulator, without affecting its capacity or its manner of charging and discharging.

Nos. 1, 2, 3 and 4 may be placed in vessels of stoneware, glass or ebonite, or in boxes of pitch-pine, painted with three coats of gum-lac, and lined with sheet lead. Nos. 5 to 12 are only sent out in pitch-pine boxes lined with lead.

The box is supported on feet of porcelain of the shape of a mushroom. If a drop of water falls upon this foot it cannot give a communication with the earth, since falling upon the broad part of the mushroom it will glide off without running along the foot which serves as the stalk of the mushroom. A slip of glass is placed under each foot; the part which supports the mushroom is covered with an insulating varnish, which prevents the formation of climbing salts, and preserves the screws from rust. A second layer of insulating varnish is applied under the head of the mushroom.

As regards the advantages of the Montaud accumulator we notice, first, its longevity.

Dr. d'Arsonval points out that the accumulators of the Planté class have a great advantage over the Faure type as regards duration, and that the most striking quality of the Montaud accumulator is its longevity.

The inventor has in his possession positive plates, five to six years old, completely peroxidised, though there remains in the interior a thin core of metallic lead sufficient to give passage to the current. The adhesion of the peroxide is such that to detach it it must be beaten with a hammer upon an anvil.

The next four points, *i.e.*, the rapidity of charge; the yield, much greater than that of any other system in proportion to its surface; its small weight in comparison with its yield; and its capacity, which for an equal weight is greater than that of any other accumulator.

In his experiments in September, 1885, Dr. d'Arsonval obtained with an accumulator of 2 square metres of surface—

Useful capacity	40 ampère hours.
Total	62 „ „
Surface	2 square metres.
Charge	10 ampères per square metre.
Discharge	20 „ „ „ „
Useful weight of lead ...	10 kilos.

Representing a total capacity of 6 ampère hours per kilo. and of discharge of 4 ampères per kilo., or a total capacity of 31 ampère hours per square metre and a useful capacity of 20 ampère hours per square metre.

Subsequently the modification of the negative plate has greatly improved these figures, which will certainly become much more advantageous in future.

The total capacity of an accumulator having exactly $1\frac{3}{4}$ metre of surface has become 87 ampère hours, which, if referred to an accumulator of 2 square metres of surface would give the following results:—

Useful weight of lead per square metre	... 5¼	kilos.
Total capacity of useful lead per kilo.	... 9·1	ampère-hours.
Total capacity per square metre ...	... 50	„ „
Useful capacity per kilo. of useful lead	... 6·23	„ „
Useful capacity per square metre ...	... 34·30	„ „
Current of charge per square metre ...	... 10	ampères.
Current of charge per kilo. of useful lead	... 2	„
Current of discharge per square metre	... 20	„
Current of discharge per kilo. of useful lead	... 4·56	„

The next advantage of the Montaud accumulator is the ease with which it can be taken out of its box and repaired without special tools and experience.

A capital defect in this respect has hitherto much interfered with the use of accumulators. In case of accidents, several kinds of which are possible, it is found very difficult to rectify the apparatus. The Montaud accumulator is much less liable to accidents on account of the firmness and compactness of its construction, and if any accident happens the repairs are simple and easy.

Lastly, the stout framework secures the apparatus from any accident due to a disproportionate charge or discharge. The peculiarities of the combs and rods already described solve this problem.

On September 8th, 1885, Dr. d'Arsonval, Professor at the College of France, wrote as follows:—"The Montaud accumulator is of the Planté type, and is extremely well conceived from a mechanical point of view. The wooden combs prevent the plates from coming in mutual contact, and give the apparatus great solidity.

"The process of formation is ingenious and rapid. To give 1 square metre a capacity of 20 ampère-hours, there is required only a quarter of an hour's treatment. To obtain the same result by Plantè's method months are required.

"The entire experiments have been effected with No. 2, which has a surface of 2 square metres. This apparatus, if charged to saturation, gives 62 ampère-hours as its total capacity, and as in the Planté this capacity constantly increases with use. The normal rule for the charge is 10 ampères per square metre, and for the discharge double this quantity. This apparatus has always given me on discharging 40 ampères at the E.M.F., of 1·85 volts during 60 or 65 minutes. The charge is effected in two hours up to 20 ampères without any appreciable loss of electricity.

"The points to be aimed at in an accumulator are longevity and energy, or rather rapid yield per kilo. From both points of view accumulators of the Planté type (and consequently those of Montaud) are far superior to those of the Faure type.

"My opinion, therefore, is that the Montaud accumulator is very practical, that it is a great improvement on the Planté type, and that it can compete successfully with the other systems in use."—*Revue Internationale de l'Electricité.*

BRUSSELS EXHIBITION.

THE following particulars of the "Grand Concours International des Sciences et de l'Industrie," which it is proposed to establish in Brussels in 1888, may be of interest.

The scheme was originated with the idea of affording some relief to the present stagnation of trade, and in the hope of, to some extent, averting the crisis which threatens to an unprecedented degree many Belgian industries. The proposal has already received not only the sympathy but the promise of the warmest support from the King, the Government and the civic authorities.

In the arrangement of the various exhibits, it is intended to depart from the system usually followed in international exhibitions. Instead of arranging the courts in separate divisions for each country, the various exhibits will be separated, and each class, material, or article, will have its own court, so that it will be rendered easy to see at a glance the progress made in perfecting any particular branch of science or industry.

The exhibition buildings proper will cover about 73 acres, and, in addition, there will be annexes devoted to agricultural and horticultural shows, military fêtes, gymnastic competitions, sports of various kinds, &c.

It is proposed to make some portion of the exhibition a permanent establishment, for the Industrial Museum, at present in course of construction by the Government, will probably be completed about the end of 1887, and by the addition certain galleries and permanent colonnades will be brought into the general plan of the exhibition.

Money prizes, gold, silver and bronze medals, and diplomas, will be awarded, and the committee hopes that the Government may be induced to create a special order of merit for the occasion.

The originators of this scheme appear to be very sanguine as to its realisation, notwithstanding the possibility of their project being to some extent swamped by the proximity of the 1889 Paris Exhibition. The necessary capital is not yet assured, and very material support from the Government will probably be needed. We notice that the executive committee has applied to the Government for permission to organise a lottery on a very large scale.

TELEPHONE SUBSCRIBERS IN EUROPE.

FROM data furnished him by Mons. A. Berthon, of the Telephone Company, Paris, France, Gen. Barney, the secretary of the National Telephone Exchange Association of America, has compiled the following table of exchanges and subscribers in Europe:—

Countries.	Exchanges.	Subscribers.	Largest exchanges.	No. of subscribers in largest exchanges.
Germany	91	14,733	Berlin	4,248
Austria	11	3,032	Vienna	946
Belgium	7	3,365	Antwerp	1,020
Denmark	2	1,370	Copenhagen ...	1,336
Spain	3	594	Barcelona	300
France	20	7,175	Paris	4,054
Great Britain.	89	15,114	London	4,193
Italy	16	8,346	Rome	2,054
Holland.....	8	2,493	Amsterdam	1,195
Portugal	2	350	.....	...
Russia	20	5,280	St. Petersburg.	1,100
Sweden	15	5,705	Stockholm	3,825
Switzerland ...	36	4,900	Geneva	1,068
Total	320	72,457		

These figures present a remarkable contrast with those of the exchange statistics of the American Bell Telephone Company brought down to January, 1886. From the data furnished by the company's statistician, it appears that on the first day of the present year there were in the United States 747 exchanges with 137,750 subscribers, or more than twice as many exchanges and nearly twice as many subscribers as in the whole of Europe, in spite of the fact that the countries enumerated above have a population five or six times as large as that of this country. The cities of the old world and the new offer other contrasts as notable. Thus, London has only 4,193 subscribers, or fewer than New York, notwithstanding the immense disparity in population. St. Petersburg, the capital of all the Russias, has barely half as many as Kansas City. On the other hand, some of the smaller cities, such as Stockholm and Copenhagen, compare very favourably with American cities of the same size, owing to the local cheapness of service.

REVIEW.

On the Conversion of Heat into Work: A Practical Handbook on Heat Engines. By WILLIAM ANDERSON, M. Inst. C.E. London: Whittaker & Co. 1887.

A course of lectures delivered by Mr. Anderson before the Society of Arts during the session 1884–5 forms the foundation of the work now before us. The object of these lectures, as stated in the preface, was to popularise the doctrine that in heat engines the work given out is due to the conversion of the molecular motion of heat into the visible motion which it is desired to produce; and further to illustrate, by numerous practical examples, the applicability of the doctrine of Carnot to defining the limits within which improvements in the economical working of heat engines is possible. With this object in view the author has produced a book which cannot fail to be appreciated by the class of readers for which it is intended, and which deals with the subject in hand in a manner which cannot fail to be understood. The volume bristles from beginning to end with practical examples culled from every department of technology. In these days of rapid book-making it is quite refreshing to read through a work like this, having originality of treatment stamped on every page.

In Chapter I. the author deals with the relationship between heat and work, discusses at length the laws of motion, and defines with scientific precision the meanings of energy, work and horse-power. In this chapter is given an interesting account of experiments on the flow of water through diverging pipes; there is also expounded the principle of the composition of forces practically illustrated by examples of the resolved motion of projectiles and the relative motions of piston and crank pin joined by a connecting rod. The author considers the effects produced by the weight of the reciprocating parts in steam engines, and explains clearly how the pressure on the crank pin is diminished at the beginning of the stroke and increased at the end due to acceleration and retardation of the moving masses.

In Chapter II. oscillatory motion is considered, the reader being prepared by the familiar illustration of the pendulum for the general theories of wave motion. The nature of the two classes of waves in which the particles move along the line of propagation and transversely thereto is described with admirable clearness and in a manner which will be easily understood by the general reader. Paragraphs on diathermancy, specific heat and absolute temperature conclude Chapter II.

In Chapter III. we pass on to the properties of gases, to the laws of Boyle, Marcotte, Charles and Gay Lussac, to considerations respecting the specific heat of air at constant volume with varying pressure and at constant pressure with varying volume. We have here explained the characters of the "isothermal" and "adiabatic" curves of a gas; we have expressions for the work done in expansion, and with an introduction to the properties of steam, we are finally led up at the end of the chapter to Sadi Carnot's ideal engine, and to Carnot's enunciation of the eternal principles of thermo-dynamics.

Chapter IV. is devoted to fuel and furnaces, the regenerative principle—which has now been adopted for the destructive distillation of coal in gas manufacture—being fully described. Chapter V. passes from a description of Cowper's blast-heating stove for blast furnaces to investigate the work done in expelling the projectile from a cannon, and to account for the various items of expenditure of the energy in the powder charge. The whole of this chapter is most interesting and ought to be thoroughly studied, since it forms, with those which have gone before, an introduction to the subject of heat engines proper, considered in Chapters VI. and VII. Introducing Chapter VI. with a description of the indicator and indicator diagram, the author considers the action and efficiency of the gas engine, taking the "Otto" as a typical form. It is shown that the effect of the water jacket is to subtract heat from the gas during compression and to make the curve an isothermal instead of an adiabatic one, which would be its form if no heat left the cylinder. The expansion curve is also found to correspond more nearly with the isothermal than with the adiabatic, this being due to the fact that heat is gained by the combustion continuing to some extent during the whole of the stroke. A balance sheet of the working gives the indicated horse-power as 28·83 per cent. of the energy which would be given were all the heat in the fuel converted into work. While Carnot's expression for the efficiency between the working temperatures employed gives ·583, the actual fraction obtained is only ·168. The hot air engine is next considered, and following that are descriptions of compressed air refrigerating machines. The last portion of the work is devoted to a description of the various forms of locomotive, land and marine steam boilers with the various appliances in use for economising fuel, and to a general description of the steam engine with an investigation of the efficiencies of various types considered as heat engines. On page 202 we have given the balance sheet of the performance of a vertical boiler, tested by Sir F. Bramwell and Dr. Russell, from which it appears that 88·29 per cent of the total energy resident in the fuel is utilised in evaporating the water. This is a much higher efficiency than vertical boilers are usually credited with. The advantages and disadvantages of single and compound engines are fully discussed in the last chapter as well as the effects of steam-jacketing the cylinders. It is stated that the fuel consumption in some of the Cape mail steamers was reduced by the adoption of triple expansion from 1·59 lbs. per horse-power per hour to 1·3 lbs. This is a very good result, but it is too soon to attempt to strike a balance between the advantages of compound and triple expansion engines, as the latter have not been sufficiently long at work, and there are other things to consider besides pounds of coal. Mr. Anderson discusses these questions from the theoretical side, and we note that his theory has led him to a very favourable opinion of Parsons' turbine engine; a departure remarkable for its boldness of design and for the high scientific reasoning upon which its construction is based. We trust that tests of this engine may justify the claims of the inventor, which are shown by Mr. Anderson to be strongly supported by theory.

In conclusion, we can heartily recommend this volume to all who desire information on heat engines. Of a thoroughly scientific texture, having for its warp the doctrine of the conservation of energy and for its weft the immutable laws of thermo-dynamics, it is woven of such materials as should find a place on the bookshelf of every student.

COST OF ELECTRIC AND GAS LIGHTING IN VIENNA.

THE new Rathhaus (Town Hall) of Vienna, a most magnificent building, in a refined Gothic style of architecture, is partly lit up by the electric light. It was at first intended to depend greatly upon electricity, and plans were drawn up for 5,013 incandescent lamps; the cost of installation was to be £19,648; but the Council, after all, rejected the proposed plans, and some halls only are lit up electrically, the rest of the building by gas. The number of incandescent lamps is now 577; of these, 13 have a luminosity of 30 candles, and the rest of 16 candles each. Two steam engines and four dynamos are employed; one large steam boiler is specially devoted to this, and three boilers, originally used for heating by steam, are used in addition when required. The coal used per hour per lamp of 16 candles is on the average 1·02 kilogrammes (2·485 lbs.). The power consumed is 1 horse per 7·4 incandescent lamps of 16 candles. The cost has

been :—Motors, £2,635 ; electrical apparatus, £2,090 ; sundries, £204 ; total, £4,930. Messrs. Egger, who have supplied the installation, undertake the charge and the up-keep for five years. For the constant expenses, wages, oil, cleaning, &c., Messrs. Egger receive £276 a year ; for the variable expenses 1·35 kreutzers (*i.e.*, 0·27d.) per lamp per hour. The cost driving ten months (July, 1885, to end of April, 1886), was :—Interest and sinking fund, £330 ; Messrs. Egger, £339 ; fuel, £129 ; water, £91 ; wages, £48 ; oil for water pumps, £7 ; total, £944. The numbers of lamp hours during that period was 139,865 ; that makes the cost of 1⅝d. per lamp per hour.

These facts were stated by M. Fausck, engineer, at the Austrian gas meeting. He went on to discuss the relative cost of gas in Siemens's regenerative lamps, reckoning the cost of the Siemens lamps but leaving the lustres for the electric lamps out of consideration. Siemens's lamps to give, in the same halls, a light of 10,410 as against 9,272 candles, would cost £335 ; the waste air pipes, &c., would be amply covered by £250 ; and so would the service pipes by £83 ; and allowing £72 for margin, the gas fittings would cost £750, as against £4,930. The cost of gas for the hours above-mentioned would be, very closely, £100 ; and to this we must add, for interest and sinking fund, £60, which makes, as the current cost of the gas system for the ten months, £160, or 0·275d. per 16 candles per hour. These figures speak for themselves.

The electrical installation has certainly cost more than the average, because special care has been taken to make it faultless ; but it has been found that the system leads to an extra expense in getting up steam when the light, as it turns out, is not wanted at all ; and, again, it sometimes happens that the steam engine is kept going to supply 20 lamps ; so the aid of accumulators is to be called in. What the result of this will be we may see hereafter.—*Gas World.*

TELEGRAPH TARIFFS.

POLITICAL economy, says M. Kugener, in the *Journal Télégraphique*, admits as an axiom that accordingly as a producer lowers his prices an increase in the number of consumers will take place, and the profits would be derived from several transactions instead of from one. On the other hand, if a loss is made it will be the greater owing to the increased number of customers, and would be augmented by every reduction in the prices.

If the producer is an individual (either a single individual or several united by common interests) he will not sell his products below the cost of production ; when the return from his work becomes insufficient, he will cease to produce.

When the State, for the benefit of the public, takes to itself the monopoly of carrying out any branch of general industry, it should fulfil its mission at least as well as a private individual would, that is to say, that with foresight and economy it ought to maintain an even balance between the receipts and the expenditure. Such should be the case with regard to the telegraph service.

It would be contrary to the general interests, as well as unfavourable to the welfare of telegraphy to wish that the State should make use of the telegraph service as a source of revenue, but we do not think that it would militate against the two points of view from which it is possible to regard the institution were we to ask that this service should yield :—1st, a revenue sufficient for its own maintenance ; 2nd, a surplus devoted to the development of the system.

On this point M. Vincheut, the eminent official whom the Belgian administration has lately lost, has expressed his opinion in No. 19, p. 351, vol. 3, of the *Journal Télégraphique*. After having shown that it is necessary, or at least very important, that a telegraph service conducted by the State should be self-supporting, that is to say, that its expenses should be covered by means of tariffs voluntarily paid by those who make use of it, M. Vincheut considers that it is even desirable that the returns should exceed the expenses and result in a permanent profit, inasmuch as this profit is employed for the benefit of the public in improvements to and extension of the service, a work which would be difficult to execute were there no profit.

We find the opinion of the German administration on the same subject in No. 33, p. 651, of the same volume of the journal.

It runs as follows :—"The changes of tariffs effected in Germany are accused of being extremely unfavourable to local traffic (which is of some moment as regards the number of telegrams), and thus causing the extinction of a large part of this particular business. To this criticism one can only reply that in no case should the greater part of the traffic be transmitted at a tariff lower than the cost of transmission, for were such a condition of affairs to exist the very increase in the number of telegrams could only result in a proportionately increasing loss. It is evident that an administration which works at a loss must be crippled in its operations, and can never command the resources necessary for the continual development of its system."

Mr. Philip Benton, one of the chief officials in the English Postal Department, does not share Mr. Vincheut's view that the foreign and transit traffic should compensate for the possible loss on the internal service (*Journal Télegraphique*, Vol. 3, No. 35, page 691), but approves of the more reasonable opinion expressed by the German Government.

It is thus evident that we are far from being alone in assigning to the question of revenue a position of principal importance. M. Zinckens, an official of the Dutch Telegraphs, prefers giving more importance to the ethical or moral view than to the financial (*Journal* for last September) ; but we are sure that M. Zinckens will admit that if the moral side of the question is the *object*, material action is the only *means* by which the desired end can be attained.

There is another feature of much consequence, but one which we do not desire in the least to exaggerate the importance of ; that is the value of the telegraph as a civilising agent. When we notice the enormous capitals employed in the carrying out of the telegraph system throughout the world the poetical halo round the institution becomes obscured ; the material interest takes the lead and monopolises our attention.

For a long time telegraphy has felt the influence of the spirit of the age. It has become a commercial institution which should produce dividends when carried out by private enterprise, as in the case of the Atlantic cables, or adjust its finances by an even balance or by an excess of receipts when a Government monopoly.

We strongly insist on this last point, for we foresee the time when in Belgium, and perhaps in other countries, the deficit resulting from internal telegraphy would no longer be balanced by the profits from international traffic, and from that moment, in these States, a raising of the internal tariffs will become inevitable.

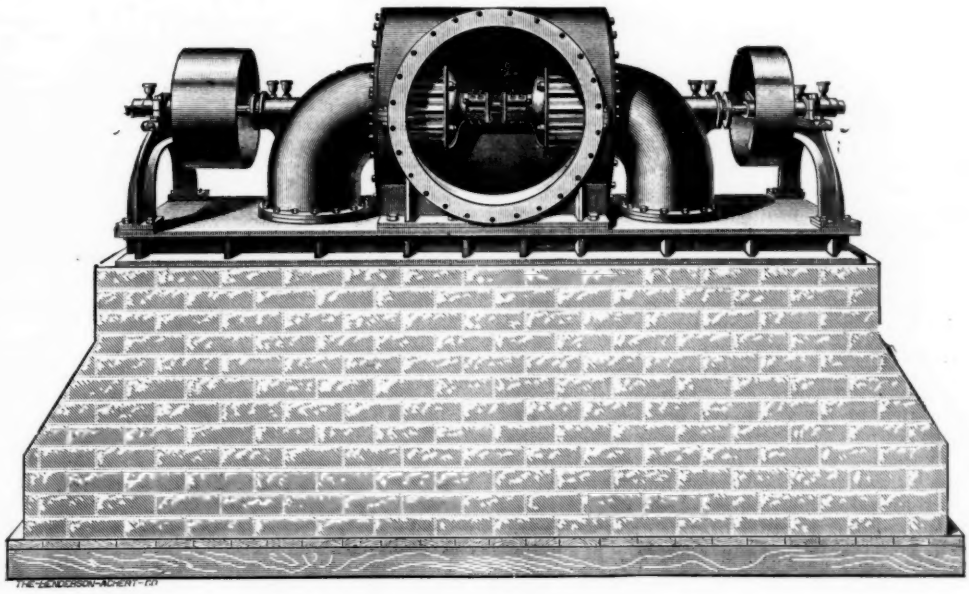
In the article which the *Journal Télegraphique* honoured us by publishing in its No. 8 of August last, we said that there was no reason to be much alarmed at the inevitable diminution in the *number* of telegrams consequent upon any raise of tariffs, and taking as a basis that which occurred in Belgium upon the publication of the Royal Orders of 15th December, 1879, and 19th January, 1880, decreeing a raising of the internal tariffs, we stated that if during the first year the traffic was affected to a considerable extent, it would not be long in resuming its gradual increase in the usual proportions.

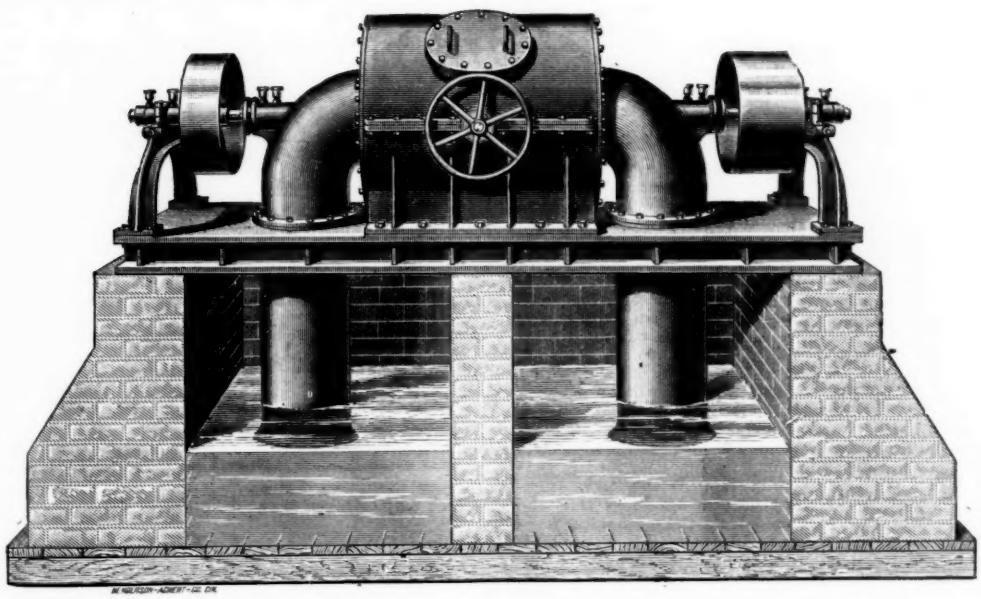
(*To be continued.*)

Incandescent Burners for Gas.—We believe that Messrs. Woodhouse and Rawson are interested in the burner which we illustrate and describe on page 3 of this week's REVIEW.

"VICTOR" TURBINES IN HORIZONTAL SETTINGS.

THE engravings herewith represent a pair of 12-inch "Victor" turbines under a 46 feet head, which were specially designed for the Aspen Electric Company, which firm, after very careful examination of the merits of all turbines brought under its notice, selected the "Victor" as yielding the greatest power under the conditions which were required. The flume, as will be seen from the illustration, contains the two 12-inch "Victor" turbines with the discharge on the opposite side. These turbines give out 166 H.P., and are used





for driving a No. 8 Brush dynamo at a speed of 800 revolutions per minute with the gates less than half open.

In addition to the foregoing we may add that two 30-inch "Victor" turbines with a similar horizontal setting are employed to drive the enormous 10 ton dynamo used by the Cowles Smelting Company, which turbines are producing 500 H.P. This dynamo is also one of the Brush build. (See REVIEW for September 10th, 1886.)

From this it would appear that the "Victor" turbine is selected for some of the leading operations in the electric world, and we commend it to the further attention of our readers, as being a matter worthy of their consideration. Mr. Frederick Nell, of 16, Mark Lane, London, will supply full particulars to all desiring further information.

THE HELSBY TELEGRAPH WORKS.

THE Telegraph Manufacturing Company, whose advertisement will be found elsewhere, is, though only recently established, likely to become an important manufacturing electrical concern. The company commenced building operations nearly 12 months ago, securing at the same time the services of several gentlemen practically acquainted with every detail of modern telegraphy and electricity. The works, which cover nearly two acres, have been erected under the personal supervision of these gentlemen, and are replete with the best and latest machinery. Helsby is, though only a small country town, an exceptionally convenient place for works of this description. It is not only within half an hour of Liverpool and Manchester, but

the centre of a competitive and expeditious railway system, enabling the company to work their traffic quickly and cheaply—two most important considerations.

Referring to the works, we may say that in the main building is carried on the covering of copper wire with gutta-percha and the making of gutta-percha sheet, rod, and tubing. Very heavy machinery is employed for this work, including choppers, washers, masticators, strainers, calenders, &c. A handsome stationary engine with automatic expansion gear, and made by Ruston, Proctor & Co., drives the whole of this section, as also the dynamos for lighting the works. The company needs an abundant supply of water for its gutta-percha work, and in boring for this were fortunate enough to strike a splendid spring at 60 feet. This spring is so strong that the water rises 10 feet above the surface of the ground, and is sufficient to supply a town of 10,000 inhabitants. Turning to the textile department where the gutta-percha and also plain wires are braided, taped, or wound, as the case may be, with cotton, silk, or India-rubber, we have a large and airy room full of delicate machines rattling along at a merry pace. In the instrument shop there are numerous power lathes, as also milling, shaping, profiling, slotting, drilling, and other machines, including automatic screw and terminal machinery. In the cabinet shop there are 12 wood working machines of the latest type. The other branches, where nothing but the best arrangements are seen, are the battery and insulator shops, the carbon and manganese crushing and preparing mill, the smith's shop, warehouse, packing shop, testing room, bobbin winding and lacquering room, &c. The machinery in these shops is driven by a Tangye engine. One of Tangye's direct acting steam pumps in connection with a system of hydrants, &c., is provided in case of fire. A 16 inch gauge tram line is laid throughout the works, rendering the removal of heavy goods from one portion of the works to another a matter of the greatest ease. We may say in conclusion that the company has been working overtime for some months, and at the present moment holds Government, railway, telephone, and private contracts, which augurs well for the new year.

NOTE ON SPECIFIC INDUCTIVE CAPACITY.*

By JOHN HOPKINSON, M.A., D.Sc., F.R.S.

CONSIDER a condenser formed of two parallel plates at a distance, x, from each other, their area, A, being so great, or the distance, x, so small, that the whole of the lines of force may be considered to be uniformly distributed perpendicular to the plates. The space between the plates is occupied by air, or by any insulating fluid. Let e be the charge of the condenser and v the difference of potential between the plates. If the dielectric be air, there is every reason to believe that $v \propto e$, that is, there is for air a constant of specific inductive capacity. My own experiments [1880] ("Phil. Trans.," vol. 172, p. 355) show that in the case of flint-glass the ratio of v to e is sensibly constant over a range of values of v from 200 volts per cm. to 50,000 volts per cm. From experiments in which the dielectric is one or other of a number of fluids and values of v upwards of 30,000 volts. per cm. are used. Prof. Quincke concludes ("Wiedemann, Annalen," vol. 28, 1886, p. 549) that the value of e/v is somewhat less for great electric forces than for small. From the experiments described in that paper, and from his previous experiments ("Wiedemann, Annalen," vol. 19, 1883, p. 705, *et seq.*) he also concludes that the specific inductive capacity determined from the mechanical force resisting separation of the plates is 10 per cent. to 50 per cent. greater than that determined by the actual charge of the condenser. The purpose of the present note is to examine the relations of these important conclusions, making as few assumptions as possible.

The potential difference, v, is a function of the charge, e, and distance, x, and if the dielectric be given of nothing else. The work done in charging the condenser with charge e is $\int_0^e v\,de$. If the distance of the plates be changed to $x + dx$, the work done in giving the same charge is $\int_0^e \left(v + \frac{dv}{dx} dx \right) de$, hence the mechanical force resisting separation of the plates is $\int_0^e \frac{dv}{dx} de$. If the dielectric be air, $A \frac{v}{x} = 4\pi e$, and the attractive force between the plates is $\frac{2\pi e^2}{A}$ or $\frac{A v^2}{8\pi x^2}$. If K_p be the dielectric constant as determined by an experiment on the force between the plates when the potential difference is v and distance is x,

$$K_p = \int_0^e \frac{dv}{dx} de \Big/ \frac{A v^2}{8\pi x^2} \qquad (1)$$

If K be the dielectric constant obtained by direct comparisons of charge and potential,

$$K = \frac{4\pi x e}{A v} \qquad (2)$$

whence

$$K_p K = \int_0^e \frac{dv}{dx} de \Big/ \frac{v e}{2x} \qquad (3)$$

We ordinarily assume that $v \propto x e$, if so, $K_p / K = 1$. These results follow quite independently of any suppositions about the nature of electricity, about action at a distance, or tensions and pressures in the dielectric.

Yet another method of determining the dielectric capacity of fluids has been used by Prof. Quincke. Let a bubble of air be introduced between the two plates, let the area of the bubble be A_1, and let P be the excess of pressure in the bubble above that in the external air when the potential is v, allowance being first made for capillary action.

The condenser now consists of two parts, one a fluid condenser, area $A - A_1$, the other an air condenser, area A_1; we have mechanical work done in increasing the area of the bubble from A_1 to $A_1 + dA_1$, with constant charge—

$$e = \int_0^e \frac{dv}{dA_1} dA_1\, de,$$

but this work is

$$x P\, dA_1,$$

whence

$$x P = \int_0^e \frac{dv}{dA_1} de.$$

Now

$$4\pi e = A_1 \frac{v}{x} + (A - A_1) f(v),$$

where $4\pi e = A f(v)$, when the whole space is occupied by fluid, and the distance is x.

The charge being constant we have—

$$0 = \left\{ \frac{v}{x} - f(v) \right\} dA_1 + \left\{ \frac{A_1}{x} + (A - A_1) f'(v) \right\} dv,$$

and for the purpose of transforming the integral

$$4\pi\, de = \left\{ \frac{A_1}{x} + (A - A_1) f'(v) \right\} dv,$$

$$4\pi \frac{dv}{dA_1} de = \left\{ f(v) - \frac{v}{x} \right\} dv,$$

whence

$$x P = \frac{1}{4\pi} \int_0^v \left\{ f(v) - \frac{v}{x} \right\} dv \qquad (4)$$

$$x \frac{dP}{dv} = \frac{1}{4\pi} \left\{ f(v) - \frac{v}{x} \right\} \qquad (5)$$

Writing with Quincke K_s for the dielectric constant determined by a measurement of P, we have by substituting in (4) $f(v) = \frac{K_s v}{x}$, and integrating as though K_s were constant.

$$x P = \frac{1}{4\pi} \cdot \frac{K_s - 1}{x} \cdot \frac{v^2}{2},$$

$$K_s = 1 + \frac{8\pi x^2 P}{v^2} \qquad (6)$$

which may be taken as the definition of K_s,

whence

$$K_s = 2 \frac{x^2}{v^2} \int_0^v \frac{f(v)}{x} dv \qquad (7)$$

but from (5) we have, since in fact $K = \frac{x f(v)}{v}$,

$$x \frac{dP}{dv} = \frac{1}{4\pi} \{ K - 1 \} \frac{v^2}{x} \qquad (8)$$

But

$$K_p = \int_0^e \frac{dv}{dx} de \Big/ \frac{A v^2}{8\pi x^2}$$

$$= \int_0^v \frac{dv}{dx} f'(v)\, dv \Big/ \frac{v^2}{2x^2}$$

$$= \frac{2x^2}{v^2} \left\{ f(v) \frac{dv}{dx} - \int_0^v f(v) \frac{d}{dv} \frac{dv}{dx} dv \right\}$$

* Abstract of paper received by Royal Society, November 9th, 1886.

Hitherto we have made no assumption excepting that energy is not dissipated in a condenser by charge and discharge. We now make an assumption concerning $f(v)$, namely, that it is in the form $\phi\left(\frac{v}{x}\right)$, *i.e.*, that $\frac{d\,v}{d\,x} = \frac{v}{x}$, or in words, that the capacity of a condenser varies inversely as the distance between the plates.

Then we have—

$$K_p = \frac{2\,x^2}{v^2}\left\{ f(v)\,\frac{v}{x} - \int_0^v \frac{f(v)}{x}\,d\,v \right\}$$

$$= 2\,K - K_s \qquad (9)$$

In words, the specific inductive capacity as determined by charge or discharge of a condenser at any given potential and distance between the plates is the arithmetic mean of the inductive capacities determined by the force resisting separation of the plates and that determined by lateral pressure, the potential and distance being the same. This is true whatever be the relation between charge and potential difference, but it is at variance with the experimental result that K_p and K_s are both greater than K.

The results obtained by Prof. Quincke are not easy to reconcile. For that reason it is the more desirable that their full significance should be ascertained. Full information is given of all the details of his experiments except on one point. It is not stated whether, in the experiments for determining K by direct discharge of the condenser, the capacity of the connection and key was ascertained. It would in most ordinary arrangements of key be very appreciable in comparison with the capacity of the condenser itself. If neglected the effect would be to a certain extent to give too low a value of K, the effect being most marked when K is large.

The property of double refraction in liquids caused by electrification is sometimes cited as showing that electrification is not proportional to electromotive force. The fact that the double refraction in a liquid under powerful electromotive forces is very small would further show that there is a close approximation to proportionality, and that the deviation from proportionality would be insensible to any electrostatic test. Such conclusions, however, cannot be safely drawn in the case of bodies such as castor oil, in which $K \pm \mu^2$. In such bodies, assuming the electromagnetic theory of light, the yielding to electromotive force is much greater if the force be applied for such time as 10^{-4} second than when applied for 10^{-14} second, and it is quite possible that the law of proportionality might be untrue in the former case, but very nearly or quite true in the latter.

Note on the Dielectric Constant of Liquids. By G. Quincke.

By opportunity of an examination of the properties of dielectric liquids (Wiedemann's Annalen, vol. 19, 1883, p. 707; vol. 28, 1886, p. 529) I had found the dielectric constant with the electric balance or with the pressure of an air bubble, measured hydrostatically, greater than with the capacity of a condenser surrounded with air or with an insulating liquid, and which is discharged through a multiplier by the reversal of a key.

The capacity of the key and that of the thin short wire connecting the key to the condenser were neglected as vanishingly small.

In consequence of a letter received from Dr. John Hopkinson, I have quite lately compared the capacity of the key and the connecting wire with the capacity, c, of the condenser by means of the indications of a multiplier at the same difference of potential of the coatings, and have obtained the relation

$$\frac{x}{c} = 0{\cdot}1762$$

much greater than I had supposed.

If we deduct the indication due to the electricity in the key and the connecting wire from the indications of the multiplier observer, s_1 and s_{11} (for the condenser in air and in a dielectric liquid) we obtain in fact by the relation of the indications thus corrected (s_1) and (s_{11}) values of the dielectric constant (K) of the liquid which agree almost exactly with the measurements by the electric balance. The agreement is as great as can be expected from the difference of the methods of observation employed.

There was thus found :—

	Dielectric Constants.	
	Multiplier. (K)	Balance. (K_p)
Ether	4·211	4·394
Sulphuret of carbon ...	2·508	2·623
" " ...	2·640	2·541
Benzol	2·359	2·360
Rock oil	2·025	2·073

[Note added December 4th.—Professor Quincke's explanation sets the questions I have raised at rest. There can be little doubt that K, K_s and K_p are sensibly equal and sensibly constant. The question what will happen to K_p and K_s if K is not constant has for the present a purely hypothetical interest.—J. H.]

Heidelberg, *December 1st*, 1886.

THE SNOWSTORM AND THE WIRES.

THE effects of the storm which burst over this part of the country on December 26th are still evident in some localities where its violence worked more than ordinary mischief. Whole armies of electricians, mechanics, and labourers have been employed in the work of repairing the telegraph and telephone lines, but there still remain several towns with which connection has not been restored, and weeks may be expected to elapse before the signs of the effect of the storm upon the wires will be entirely removed.

The United Telephone Company was necessarily a great sufferer through the breakage of wires and downfall of posts. The wires for the most part held out against the tremendous strain to which they were exposed by the accumulation of wet snow upon them and the driving of furious wind. But the posts and derricks gave way in all directions. Among the mishaps was the breaking of a pole or a derrick through the roof of a house and the smashing up of a dinner, though happily the dinner party seems to have received no injury. All over London the supports of the lines proved to be the weak points of the system, and where these went, of course, the lines were slackened and inextricably mixed up with each other. Over many thoroughfares they were festooned in the greatest confusion. Over Bishopsgate Street, for instance, hardly a wire seemed taut. The vast accumulation of them were slacked down over the streets like huge cobwebs, and on many of them were accretions of frozen snow, just the remnants of the insupportable burden which the night before had brought down the poles. Appropriately enough, the climax of mischief seems to have occurred over the head office itself, in Salter's Hall Court, Cannon Street. There was a very large derrick here holding up an immense number of wires and a good many cables, and this derrick was partly supported by guy-lines attached to one of their own comparatively new and solidly-built chimney-stacks. The derrick utterly collapsed under the strain imposed upon it, and in its fall completely wrenched the upper half of the chimney off its base and twisted it round.

The German papers gave expression last week to the loud complaints which have been raised on the Continent by the interruption of telegraphic communication with England. It would cost a mere trifle, said they, to lay a subterranean wire from Dover or Lowestoft to London, and thus once for all put a stop to "these ever recurring calamities." The reason why this is not done, they asserted, was the fact that it is not the English Government, but a telegraph company which possesses a monopoly of the international telegraphic traffic in England. This assertion naturally brought Mr. S. M. Clare, the secretary of the Submarine Telegraph Company, to his feet to point out that no one telegraph company possesses a monopoly of the International traffic, which is shared by the Government and a number of companies with lines to various parts of the Continent.

In connection with this subject, the Berlin correspondent of the *Times* on Tuesday called by appointment on Dr. Von Stephan, Imperial Postmaster-General, to whom he had expressed a wish to know something of the admirable system of underground telegraphs existing in Germany, "a system which, if even partially adopted in England," says the correspondent, "would obviate the recurrence of such a calamity as has lately severed that country completely from the Continent as far as the ordinary means of 19th century intercourse are concerned. After some general conversation with Herr Von Stephan, who mournfully referred to the disastrous results of such a telegraphic catastrophe, even for Germany, his Excellency introduced me to one of his specialists, from whom, among other things, I learnt the following brief but eloquent facts. Such a collapse of telegraphic communication as lately plunged England in something like Egyptian darkness would be impossible in Germany, for Germany is enclosed in an elaborate net of underground wires. These were first taken in hand in the year 1876—Berlin to Halle being the first line laid—and by 1881 the project had been completed. This net, which includes all the chief commercial and military centres of the Empire, extends from Königsberg in the north-east and Metz and Strasburg in the west, and consists of trunk and branch lines, forming a total length of about 5,463 kilometres of cable, or 37,372 kilometres of telegraphic wires, each cable comprising from seven to four wires, according to the pressure of intercourse in various districts. The total cost of laying this 5,463 kilometres of cable was only 30,200,000m., or little more than one and a-half million pounds. So that the paltry expense of connecting London and Lowestoft or London and Dover by underground wires can easily be calculated. As far as time is concerned, the cable, for example, between Berlin and Halle, 176 kilometres, was laid in about three short months; and what could not English energy accomplish in the same period? All the cables only require a narrow trench one metre deep, this being quite sufficient to protect them from the extremes of soil temperature, whether heat or cold. They generally follow railway routes or turnpike roads, these, as a rule, forming the shortest available distance between two given points. It is true that overhead wires work a little better *ceteris paribus* than underground cables, owing to the effect of what is technically called induction on the conducting power of the copper wires, but on the other hand the expense of maintaining the former in good order is sometimes as much as 19m. per annum for every kilometre, while the latter cost next to nothing, and this in itself is surely a very serious consideration. It must not, of course, be supposed that in Germany the overhead system of telegraphy has been discarded; on the contrary, the great bulk of correspondence is still forwarded over pole-supported wire, but

as the German army is organised on the basis not only of regimental but also of strategic reserves, so the telegraph system of this wonderful nation also provides for all emergencies of snow, lightning, thunder, roving Cossack, or invading Gaul. It was probably the military necessities of the Empire as much as anything that gave rise to the idea of a telegraph cable net, but meanwhile the ordinary and every day interests of the country profit greatly by its existence. To Germany belongs the enterprise and the honour of leading the way in this direction, and France is the only other nation which has imitated her example, though as yet to a very timid and limited extent. Efforts have been made in Berlin to induce France to connect Paris with the German frontier by a subterranean wire, but hitherto this object has not been attained. The violent storms which swept over Europe, in January, 1884, interrupted telegraphic communication for a brief but painful period in England, France, and Belgium, but they affected not the intercourse of Germany with her underground wires, and the same can be said of the recent heavy snowfall, which stopped traffic for a few days on all the chief lines. As to the question who is most to blame in England for the late catastrophe, the Government or private companies, it is pointed out by the *North German Gazette* that the concession of the Submarine Company not only holds good for the transmission of messages over the sea line, but also for the land route between Dover and London, so that the company has, in point of fact, control of all the International intercourse by this route, and ought also, therefore, to provide for it. In any case it is earnestly hoped here that the question will now be seriously considered and solved in the only possible manner either by the Government or the company, or both."

Mr. R. Booth, a surveyor, suggests, in the *Daily Chronicle*, a novel method, too good to be lost to our readers, of avoiding the inconveniences recently experienced. He says:—"It is admitted by the Press, almost universally, that in large cities telegraph and telephone wires should be restricted to a passage beneath the surface, and that snow must be got rid of by a quicker process." He then suggests a way of clearing a passage through the snow by means of a bent sheet of iron attached to a frame of wrought iron, extending from the rear of an ordinary cart. The snow should then, he says, be collected in mounds over gully-holes, and in these holes batteries and coils with suitable apparatus would cause the snow rapidly to disappear. "The work can be renewed *ad infinitum* over a dozen gully-holes at one time. Of course it will be said what shall we do with the batteries for the remainder of the year. The answer should be, deposit them in subways to be made beneath pavements where they may provide for adjacent dwellings a substitute for gas. They will not subsequently be required to be brought to the surface for the destruction of snow, as apparatus can be fed for that purpose by the batteries permanently placed in the subways, which they may serve to illumine."

"Dogberry" relates the following in the *City Press*:—"At the corner of a street, near where the Dover Road commences, some evil-disposed persons tied the door and knocker up with the ends of some of the overhanging wires. When the occupant came down he could not open his own door, and had actually to get out of his first-floor window before he could free his street door from telegraphic obstruction."

The same writer states that in the mess-room of Bishopsgate police-station and on the roof there were, a week after the storm, "miles and miles" of telegraph wire, picked up in the immediate neighbourhood. Though the wires were blown down in almost every street, yet not a single piece was hanging about at mid-day on Monday. This last circumstance "Dogberry" attributes to the vigilance of the City police, whom he compliments, together with the City authorities generally, upon their conduct after the storm.

Sir H. W. Tyler, writing to the *Times* last week, said:—"Anyone who walks about London to-day will see, if he diverts his attention from the slush in the streets, hundreds and hundreds of overhead wires which have succumbed, like the cedars and other trees in our gardens, from the effect of last night's snowfall. Both in the City and at the West-end great has been the destruction. Broken and bent telegraph posts on the roofs, wires rolled up and put away in corners, with ends hanging or tied round railings or lamp-posts, are visible in all directions. Telegraph and telephone communication has been materially interrupted, in the metropolis as well as throughout the country. The expense of the reinstatement of these posts and wires will necessarily be considerable; and there will be the same liability to destruction when four inches of snow again falls suddenly. But the most serious part of the question is the danger to life and limb which is constantly incurred by the suspension of this constantly increasing network of wires over the heads of the hundreds of thousands of people who are constantly using the streets. There is, no doubt, a certain amount of temptation to allow, for the sake of cheapness, convenience, and profit, this danger to be continued, and it will be an uphill battle to fight before the happy consummation can be arrived at of burying these wires underground. But it will have to be done sooner or later, in this as in other cities, by the Post Office, the telegraph companies, and the telephone companies, as it has already been done to a great extent in some cities and by the Post Office here. The report of the recent Parliamentary Committee was not considered a success, even by some of those who were concerned in framing it. And, indeed, it is sufficiently obvious to all who are acquainted with the strength and durability of materials, with the tendency of wire to fly when stretched tightly and fractured, and with the weakness of the human frame to resist flagellation so administered, that serious and increasing dangers are the result of the present system. Unless, by pegging away, we can sooner cause the remedy to be adopted, we must wait till serious accidents and loss of life in high quarters have been occasioned; and then we shall, no doubt, be relieved from the bird-cage existence to which we have now for many years been more and more trained."

The storm, says the *Times*, has again raised the question, Why should not the whole of the Post Office wires be placed underground? Successive Postmasters-General have considered the problem, but it has not yet been solved. The initial difficulty is, of course, the enormous cost which such a work would involve. It has been officially calculated that to introduce the alternative underground system merely in connection with the provincial towns would lead to an expenditure not far short of £3,000,000; but beyond this there has further to be taken into consideration the fact that the most improved telegraph appliances cannot be used in connection with underground wires. This is specially the case with the Delany multiplex apparatus, by which six different messages can be transmitted simultaneously by overhead wires, while not more than three can be sent where the wires are for any considerable distance underground.

With regard to the damage to the overhead wires in Chelsea by the snowstorm of the 26th ult., the vestry was informed by the surveyor at the last meeting, that there were in the home district of the parish 122 standards, of which 16 were broken or displaced, and 1,280 wires, of which 210 were broken, 256 hung loose over houses and streets, and 45 were slightly sunk from standard to standard. Of the posts 13 per cent. were damaged, and of the wires 36½ per cent.

NOTES.

Electric Light in the Royal Navy.—The torpedo cruiser *Arab* has been fitted with two powerful search lights, one for stern and the other for bow chasing. Internally the vessel is illuminated with 190 incandescent lamps. Orders have been received from the Admiralty directing the *Conqueror* to be fitted with two additional search lights, making the system of electric lighting in the ship of a most perfect character.

Electric Lighting in the Suez Canal.—According to information received from the three directors of the Suez Canal Company who are now in Egypt, the whole length of the canal will be ready in about a month for night traffic by steamers provided with electric lamps.

Edison's Electric Lighting Systems in America.—The stockholders of the Edison Electric Light Company and the Edison Company for Isolated Lighting, representing 7,700 of the 10,000 shares of stock, held a meeting recently and consolidated the two companies, which will be known as Edison Electric Light Company. The change consists in dropping the word "the," but otherwise the company is the same as the old one. The report of the old company showed that in the past year more money was earned than in all the previous years added together. The new stock in place of the old was ready and all of it was taken.

Central Station Lighting in Berlin.—In Berlin there are seven electric light stations. Four belong to the Edison Company, two to the Berlin Electric Lighting Company, and one to Siemens and Halske. These supply together 252 arc and 17,800 incandescent lamps.

Electric Lighting of Yorkshire Mills.—Mr. Wilson Hartnell has just completed the lighting of Messrs. W. and J. Bairstow's mill at Skipton. The plant consists of one of Hartnell's usual type of compound-wound self-regulating dynamos and 58 16-candle power Edison-Swan lamps of the latest pattern, with movable lamps for use in examination of machines, silks, &c. The dynamo is driven by a 4-horse nominal vertical engine fitted with Hartnell's patent automatic governors, the power being transmitted direct by belting. The installation is giving the greatest satisfaction, as is also the plant which Mr. Hartnell put in for the same firm some four years ago. Mr. Hartnell has received an order to light the mill of Messrs. Croysdale and Son, of Knottingley, throughout.

Electric Lighting of Steamers.—Last week Messrs. Barclay, Curle & Co., Whiteinch, launched a steel screw steamer named the *Hare*, which is to be fitted throughout with the electric light by Messrs. W. Harvey & Co., Glasgow. This vessel, which has been built to the order of Messrs. J. & W. Burns, is for their Belfast Royal Mail service.

A fleet of steamers, designed by "a well-known shipmaster," is to be built on the Clyde for trade out of New York. The outfit of these steamers is to be superior to anything ever engaged in the trade they are intended for; they will, amongst other things, be lighted throughout by electricity.

Electric Lighting in Antwerp.—The workshops of the Antwerp lapidaries have been successfully illuminated with the electric light. It was found that gas did not give a sufficiently steady light, and was, besides, very trying to the eyes.

The Electric Light in Rome.—The Roman Gas Company has taken the initiative by establishing in Rome a central electric light works, from which it is intended to light the following buildings :—

Chamber of Deputies ...	...	1,800	incandescent lamps.
Argentine Theatre ...	...	2,000	„ „
Paise „ ...	...	300	„ „
National „ ...	...	400	„ „
Quirinal Palace ...	...	800	„ „
Ministry of the Interior ...		180	„ „

These works will be fitted with the means for lighting 18,000 incandescent lamps, and are being erected at the gas company's works in the Circo Massimo. They will contain :—Four large alternating current machines, each capable of feeding 4,000 16-candle incandescent lamps. The speed of these machines will be 125 revolutions per minute. Two smaller alternating current machines, each capable of feeding 1,000 16-candle incandescent lamps. Three dynamos, especially employed to maintain the magnetic field of the large machines, the smaller ones being self-exciting. Each of the large machines is worked by a motor of 600 horse-power, the smaller machines being each driven by 150 horse-power.

The Telephone in Bohemia.—In addition to the lines recently reported as being undertaken by the Austrian Government, the latter is now engaged in elaborating plans for introducing long distance telephony in the north-east of Bohemia, which is the most industrial portion of that country. A further extension of the telephone in Salzburg and neighbourhood is also probable.

The Telephone in North Devon.—Dr. Rouse, of Bideford, North Devon, has introduced the telephone into that part of the county, by establishing a "gossamer" link with Westward Ho! where his assistant, Mr. Gooding, resides. The work has been carried out by the Western Counties and South Wales Telephone Company, the distance of wire being two miles and a half. It is hoped to make considerable progress with the telephone in North Devon now that a start has been made.

American Telephone Patents.—On December 7th, a motion on the part of the Government for the dismissal without prejudice of the suit against the Bell Telephone Company was heard in the United States County Court at Columbus, O., and the judge acceded to the motion. The object of this procedure, it is understood, is to facilitate the bringing of another suit in the Massachusetts Courts.

Telephone-Cum-Telegraph.—A Boston paper has this :—"A story, started two or three days since, and which at the time received little credence, but which is now believed to have a very substantial basis, is to the effect that negotiations for the control of the Bell Company by the Western Union Telegraph Company are in progress, and what is more are in a fair way to assume definite shape."

Telephone Work in 1886.—The New Telephone Company sends us the following particulars of some of the most important of its private line work carried out during the year 1886. Among the principal installations were :—The Bessbrook Spinning Company, Limited, at Bessbrook, Ireland, 10 instruments. Considerable difficulty was experienced here in consequence of the induction from the electric railway alongside which the company was compelled to run the telephone lines. The installation was, however, successfully accomplished, and was the more satisfactory to the New Company as the Bell telephone had been tried, but suffering so much more from induction than the Thompson it had failed. Broadmoor Asylum, 15 sets connect the various blocks of buildings. This installation was carried out by Messrs. Paterson and Cooper, the fixing of the apparatus being supervised by one of the company's staff. Messrs. Wenham and Waters, of Croydon, have been supplied with 13 sets for public offices in Jersey. At Messrs. Bayley and Sons, Poole, Dorset, the instruments continue to work thoroughly well through a line five miles in length from Poole to Bournemouth. Messrs. Ritchie & Co., of Stroud, have sent another testimonial to the effect that the company's instruments, fixed 12 months ago, continue to give the most excellent results in spite of the noise of machinery. Whiteley's, Westbourne Grove, and Messrs. Huntley and Palmer's, of Reading, have the company's instruments. In Lancashire, several private exchanges, varying from three to 10 instruments have been fixed by the company's agents, and in mills, foundries, coal pits, &c., in all parts of the United Kingdom instruments are at work, and the company is constantly receiving testimony of its customers' satisfaction. Messrs. Tasker, Sons & Co., of Sheffield, licensees for that district, have been busily engaged with installations. Numerous applications have been received for the establishment of exchanges in towns and cities of the United Kingdom, and the whole question is under the consideration of the directors. The company is at the present moment actively canvassing in Chelsea, in which district it proposes shortly to open an exchange.

Telephoning between Paris and Brussels.—At a Ministerial Council held in Paris, on Tuesday, the Minister of Posts and Telegraphs submitted for the signature of M. Grévy the convention and tariffs for the telephone between Paris and Brussels.

Australian Cables.—Mr. Matrieff, superintendent of the Queensland telegraphs, and Mr. Starke, electrician, visited Thursday Island from Brisbane, to superintend the laying a cable from Cape York to Thursday Island, a tender for which was accepted some time since from the Eastern Telegraph Company.

The New Zealand Cable Subsidy.—The difficulty between the New Zealand Government and the Eastern Extension Telegraph Company has been temporarily arranged, the company accepting the Government proposal to revert to the old arrangement for six months, except in regard to Press rates, which will be reduced by 3d., conditionally on the gross receipts equalling the previous amount.

Messrs. Walter T. Glover & Co.—We are informed that Mr. Henry Edmunds has become a partner in the firm of Walter T. Glover & Co., the electrical wire and cable makers, of Salford, Manchester. The firm has taken new London offices at No. 10, Hatton Garden, E.C. Mr. Edmunds, who will continue to reside in London, was associated with many important electrical undertakings in connection with the earlier introduction of arc and incandescent lighting. He brought over the first American series arc light machine, the Wallace-Farmer. He was also concerned in the introduction of the Brush system, the development of the Swan and Hochhausen systems, and in the first installations of incandescent ship and theatre lighting.

The Late M. Paul Bert.—The writer of the Paris article in yesterday's *Daily Telegraph* says :—"Paul Bert wrote a characteristic letter to M. Marcel Deprez a short time before his death at Hanoi, which place the late Resident-General described as being bathed by a powerful and rapid river, 875 yards wide, and with a depth of from 16 feet to 32 feet. M. Bert, however, complained of the darkness of the place at night, and as he found gas too dear and petroleum too primitive he asked M. Deprez 'if the river could be utilised for lighting purposes.' 'Think over it,' concluded the Resident-General; 'if we succeed we shall beat England, and even Japan. Answer me quickly, for my days are numbered.' This letter, which has been communicated to the French Academy of Science by M. Bertrand, will be kept among the archives of the institution."

Underground Conductors.—The *Standard* of Thursday in an excellent leading article anent the recent storm and the telegraph wires says :—"Only a very rash man would advocate the burying of all of our lines. Overhead wires are still plentiful in Germany, and, indeed, most of the messages despatched in ordinary times come along them. The trunk lines and their connections only are put underground, and all that anyone would dream of asking at present would be that the same system should be established here. The principal ports and fortresses must be put into underground communication with the Admiralty and the War Office, and the great trunk lines connecting such commercial centres as Birmingham, Liverpool, Manchester, Newcastle, and Glasgow should be equally safe from the mishaps which follow wind and snow. And the lines leading to London from the English ends of the Continental cables should be buried. This, for a time at least, would suffice. The cost could not be very great, and assuredly, considering the loss sustained within the last few days, and the serious national catastrophe which in easily imaginable circumstances might result from a breakdown in our overhead telegraphs, the expense ought not to be taken into consideration. In a few hours after the snow shower of December 26th, only six out of 560 wires connecting the metropolis with the provinces were left standing."

The Union Storage Battery.—The Union Electrical Power and Storage Company, of 127, Cannon Street, London, is introducing a new battery possessing some valuable special features. The peroxide plate is solid, without any lead support, thus avoiding all local action. This plate is fixed in a kind of sling made of a gelatinous-looking material, which is quite impervious to acid and indestructible, and contact is made by a narrow strip of platinum. The same material makes a very light lining for the cells. The plate itself is so highly conductive that it is equally discharged in all parts from the same contact. It is hard, durable, extremely porous, and of very high capacity. The internal resistance of the battery is very low. A cell weighing about 76 lbs., including electrolyte, has a capacity of about 1 H.P., and can be discharged at from 1 to 45 ampères, stopping the discharge when the E.M.F. falls to about 1·8 volts. It is claimed that an increase of over 50 per cent. in the relative amount of work to weight is obtained over other lead batteries. In practical working, it is proposed that when a consumer requires his elements to be recharged the company shall remove the batteries, charge them from a dynamo at their works, and re-deliver, the consumer being able to keep a supply always ready for use. In the system initiated by this company, only the elements of the battery, not the weighty box and fluid, require to be transported. We shall probably refer to the matter again next week.

Patents of 1886.—The number of applications for patents during the past year was 17,162, a number slightly in excess of any previous year. In 1884 there were 17,110, but in 1885 there was a falling off of a thousand.

Electric Railways.—The plans for the electric railway in Buda-Pesth have been definitely adopted, and the works will be commenced at once. The construction will be undertaken by the firm of Siemens and Halske, of Vienna. The same firm has also obtained from the Austrian Ministry of Commerce a provisional concession for the construction of an electric railway between the Lend Station on the Strasbourg railroad and Wildbad-Gastein. The concessionaires intend later on to prolong their line so far as Bockstein.

New College for Railway Employés.—It is proposed to establish in Hungary a new college for the education of railway men. Applied electricity is amongst the subjects to be taught.

The Jubilee Year and Electro-Plating.—The approach and arrival of the jubilee year are said to have had a beneficial effect upon the electro-plating trade, and consequently upon the German silver and nickel trades.

Terrific Gas Explosion.—Portsmouth was terribly startled on Sunday night by a fatal explosion which occurred in the Cambridge Barracks, the headquarters of the 2nd Worcester Regiment. A few minutes before nine o'clock, a loud report, as of heavy ordnance, was heard throughout the borough, and those residing in the vicinity of the barracks felt a distinct vibration and shock, resembling that of an earthquake. There is little doubt that the cause of the explosion was a leakage in the gas pipes on the basement which had been known to exist for some days, and which, it is rumoured, was of such a serious description that the men had recently been obliged to sleep with their windows open. An accumulation of gas is supposed to have taken place underneath the boards, and a light having been applied in some way or other the accident followed, the whole of the front of the ill-fated structure, including the three floors, collapsing with a tremendous crash. As quickly as possible a large detachment of soldiers were set to work with pick and shovel to extricate those who were known to be buried beneath the heap. The labour of extrication proceeded all through the night until late on the following morning, and during the dark hours a host of lanterns had to be used in order to guide the men in their search. When the demolition of the gigantic mound of *débris* had been completed, it was found that three men had been killed on the spot, and that 17 others had received severe injuries, of whom one died shortly after his admission to hospital from shock to the system, occasioned by extensive hurt to the jaw.

Electric Safety Lamps.—At the last meeting of the Mining Institute of Scotland information was given regarding the cost and action of Pitkin's miners' electric safety lamps, and arrangements were made to have six of them tried at Earnock Colliery.

Finsbury Lectures.—The special evening lectures at the City and Guilds Technical College, Finsbury, are to be devoted from January to the end of March to the subject of the steam engine indicator diagram. The six lectures on this subject are to be delivered by Prof. Perry, D.Sc., F.R.S., on Thursdays, commencing January 20th; alternate Thursdays being devoted to laboratory demonstrations. A number of special pieces of apparatus, illustrative of the mechanical principles of indicators, have been devised by Prof. Perry on purpose for this course, which, though treating of a very special branch of the subject of engineering, has many points of great importance to electrical as well as mechanical engineers. In the electrical department the special lectures on electro-plating have come to a conclusion, but the general courses on the technical applications of electricity continue as usual. The lectures of the elementary course during the months of January and February will be devoted to primary batteries, thermo-generators, galvanometers, &c. The lectures of the advanced course will treat of electric motors, accumulators, secondary generators, &c.

"Union Storage Battery."—*Punch* recently had the following politico-scientific item :—The new machine belongs to the Union Electoral Power and Diffused Light Company, and is worked on "Chamberlain's Patent." In the course of the next two months Mr. Chamberlain will exhibit its qualities at Hawick, Ayr, and Edinburgh, previous to a grand display at Birmingham. In this battery there is said to be no waste of power by local action, and no danger is incurred by the useless consumption of expensive material.

Defunct Electrical Companies.—Amongst the companies whose names have been struck off the register at Somerset House are the European and American Telegram Company, the National Electric Light Corporation, and the Universal Telephone Company. Further particulars of these companies will be given in our official list of companies in next week's issue.

To Aspirants for Fame.—We have been informed that a well-known and long established electric light company requires the services of a gentleman who will undertake the duties of secretary, manager, and engineer at a salary not exceeding the wages of a good mechanic. To those to whom money is not so much an object as the opportunity of acquiring renown, we commend the above. Our private opinion is, however, that the game is not worth the "candle."

Personal.—Many of our readers will be sorry to learn that on Christmas Eve, after retiring to rest, Mr. W. E. Langdon, the well-known telegraph engineer to the Midland Railway Company, ruptured a blood vessel. We are glad to say, however, that from the latest accounts he is steadily progressing towards recovery.

Reporting Scientific Lectures.—Judging from the contents of the letter which Mr. Mailloux contributes to our Correspondence columns we are better off in this effete old Monarchy than are our cousins over the water. Reports of lectures or papers read at scientific meetings are, we fondly believe, generally found to be at least approximately correct when published in the pages of our technical journals.

The Liverpool Exhibition.—A meeting of local theatre managers and representative tradesmen was held in Liverpool on Tuesday to protest against the continuation of the Liverpool Exhibition for another year. A general opinion was expressed against the proposal, which, it was stated, would be damaging to places of amusement and to the tradesmen. A memorial embracing the sentiments of those present was unanimously adopted, and a deputation appointed to present it to the City Council.

The Folkestone Exhibition.—According to a statement just issued the deficit in respect of the Folkestone Art Treasures Exhibition is about £27,000, which will require about 55 per cent. of the amounts guaranteed.

Electricity and Lifeboats.—The *Times* badly needs instruction in electrical matters. We have before called attention to some of its eccentricities, and now, in an article on lifeboats, we find the following utterance :—"If steam should not be available as a propelling power, is it not possible that before long some use may be made of electricity ? Accumulators might possibly be so fixed as to form a portion of the ballast, and to increase that overbalancing weight of the keel on which the power of self-righting depends." We leave this suggestion without further comment for such consideration as our readers may care to bestow upon it.

Telephone Concessions.—We would draw attention to our article on telephone legislation in Spain, which seems to indicate the road for future developments of telephony.

The Academie des Sciences.—The subject for the Grand Prix des Sciences Mathematiques of the above society was, "The perfecting in some important point the theory of the application of electricity to the transmission of work." Only a single memoir had been presented ; this memoir, in spite of various interesting points of view which had been considered, and a skilful discussion of the problem did not appear to the Council to be sufficiently in accordance with the programme put forward by the Academie, and it was therefore decided not to part the prize, but to offer the latter for further competition on the same subject, the memoirs to be sent in not later than June 1st, 1888.

Opinions of Experts.—It may be interesting to know, in connection with the report given by Messrs. Mackenzie and Brougham on the process of metal extracting mentioned in our leading columns, that the Hon. R. Brougham figures as one of the directors of the Electro Metal Extracting, Refining, and Plating Company for whom the experiments were made. We fear that under these circumstances the value of the report is somewhat reduced.

The Dangers of Gas Lighting.—The Roman Catholic church of St. Thomas of Canterbury at St. Leonard's was completely destroyed by fire on Monday morning. Some very valuable paintings and relics were also destroyed. It is believed that the fire was caused either by an escape of gas being ignited by a small light which had been burning all night, or that some of the decorations caught fire.

On the same day as the Portsmouth disaster information was given to the authorities that Mr. H. Wilding, a retired gentleman residing at Holly Cot, Station Road, Sidcup, had succumbed to injuries received by an explosion of gas at his residence. Much damage was also done to the property.

A serious explosion of gas occurred at Bicester on Tuesday at the residence of Mr. Walker, a saddler, whereby several large panes of plate-glass were smashed and the proprietor of the shop was badly burned about the arm and face.

Two more deaths have resulted from the escape of gas which was discovered in a dwelling house in Dundee. When the discovery was first made a widow and her daughter were found suffocated, and a man and woman were in a very exhausted condition. The latter were taken to the infirmary, and both died on Wednesday.

Telegraph Revenue.—An abstract of the gross produce of the revenue of the United Kingdom during the year ending December 31st, 1886, gives the following comparative statements of the receipts on the telegraph service for the quarters ending on the dates given :—Quarter ending March 31st, 1886, £395,000 ; June 30th, £425,000 ; September 30th, £515,000 ; December 31st, £445,000. Quarter ended March 31st, 1885, £405,000 ; June 30th, £445,000 ; September 30th, £490,000 ; December 31st, £410,000. Total for the year 1886, £1,780,000 ; that for the year 1885, £1,750,000, or an increase in the twelvemonth of £30,000.

NEW COMPANIES REGISTERED.

Electric Battery Brush Company, Limited.—Capital £50,000 in £5 shares. Objects : To purchase the British, American, German, Belgian and French patent rights granted to Miss Mary McMullin for improved electric brushes and composition of the exciting fluid, and the rights in respect of patents in foreign countries and the Colonies (except Victoria) either already applied for or which the directors may think proper hereafter to apply for. To establish works for the manufacture of electric brushes and composition fluid, small wares, and other articles, for which the machinery and methods of the company may be appli-

cable. Signatories (with one share each): Thos. Leonard, 5. Muschamp Road, Peckham; J. Murphy, Wood Lane, Highgate; H. Govey, 52, Overbury Street, Clapton Park; W. Herbert, 4, Staples Inn; John Bury, Devereux Chambers; H. Hinds, F.E.I.S., 58, Mall Road, Hammersmith; F. Griffiths, 13, Colebrooke Terrace, N. The company is incorporated under Table A of the Companies' Act, 1862, in accordance with which the signatories appoint the first directors and act as directors *ad interim*; remuneration £1 1s. for each attendance at a board meeting. Registered 31st ult. by Thos. Leonard, 5 Muschamp Road, Peckham.

John Kirkaldy, Limited.—Capital £50,000 in £10 shares. Objects: To acquire the freehold and leasehold premises at or near East and West India Dock Road and the engine works, Albert Dock, where the business of John Kirkaldy is carried on, also certain freehold land and premises at Burnt Mill, Essex, where a factory comprising foundry, smith's shop and other buildings is now being erected by John Kirkaldy; and to carry on the business of marine, electrical and general engineers. Signatories (with one share each): *Wm. Mactaggart, 34, Leadenhall Street; Hy. Parkinson, 13, Bolingbroke Road, Sinclair Road, W.; *J. Rogers Pascoe, Norway Wharf, Limehouse; *J. Rodgerson Anderson, 4, St. Mary Axe; *John Kirkaldy, 40, West India Dock Road; E. Seabury, 10, Tabernacle Avenue, Barking Road; E. Chapman, 34, Great St. Helens. Directors' qualification 20 shares; remuneration £200 per annum, and in addition thereto 10 per cent. of the annual net profits beyond 7 per cent. upon the paid-up capital divided by way of dividend. Mr. John Kirkaldy is appointed managing director at a remuneration of £600 per annum, until the 1st January, 1894. Registered 1st inst. by Trinders & Co., 47, Cornhill.

* Signatories whose names are preceded by an asterisk are also directors.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Woodhouse & Rawson Electric Manufacturing Company, Limited.—The annual return of this company made up to the 30th ult. was filed on the 1st inst. The nominal capital is £100,000 in £10 shares. 4,728 shares have been taken up, and the full amount has been paid thereon, the paid up capital thus standing at £2,200 in excess of the amount recorded in the previous return.

Equitable Telephone Company, Limited.—An agreement dated 21st ult. (filed on the 1st inst.), between Allan Archibald Campbell Swinton, of 43, Grove Street, Newcastle-on-Tyne, and the company, provides for the purchase from the former of several inventions relating to electric telephones, telephonic apparatus and transmitters. The purchase consideration is the allotment to the vendor of fully paid B shares equal to the number of A issued up to the 25th inst., and a similar proportion of B shares for every further issue of A shares. Registered office, 32, Craven Street, Charing Cross.

Taunton Electric Lighting Company, Limited.—An agreement dated 30th ult. and filed on the 31st ult. provides for the purchase of the business carried on by Mr. H. George Massingham, under style of the Taunton Electric Lighting Depôt for £6,000, whereof £3,000 is payable in fully paid shares.

Buenos Ayres Electric Lighting Company, Limited.—The annual return of this company, made up to the 29th ult., was filed on the 30th ult. The nominal capital is £100,000, divided into 9,986 shares of £10 each, and 70 founders' shares of £2 each, but the latter are the only shares taken up, and upon these no call has been made. Registered office, 1, East India Avenue.

Pacific Telegraph Company, Limited.—The registered office of this company is situate at 34, Clement's Lane, E.C.

Telephone Company of Austria, Limited.—The registered office of this company is now situate at 53, New Broad Street, E.C.

River Plate Telephone and Electric Light Company, Limited (in liquidation).—The registered office of this company is now situate at 53, New Broad Street, E.C.

Edison-Gower Bell Telephone Company of Europe, Limited—The registered office of this company is now situate at 53, New Broad Street.

CITY NOTES.

Simplex Electrical Syndicate, Limited.

THE first ordinary general meeting was held last week at the offices, Farringdon Road. Mr. C. L. W. FitzGerald presided.

The Chairman, in moving the adoption of the report, observed that the syndicate had been formed for the purchase and working of certain patents, the principal being for an arc lamp and an electric printing machine or tape record. They at the outset thought there would be a very ready sale for their arc lamp on account of its steadiness and cheapness, but subsequently they discovered that nearly every large manufacturer in the business already had an arc lamp patent. The result was that instead of selling the lamp to any great extent, as they had expected, they had found it would be necessary to undertake installations. Their capital, however, was not adequate for that, and therefore they had come to the conclusion, after due consideration, that it would be best for them to try and sell the patents they had taken out. Patents for the arc lamp had been taken out for the United Kingdom, Austria, Belgium, France, Germany, New South Wales, New Zealand, South Australia, and Victoria. They had had trials of the lamp at various places, the most satisfactory, perhaps, having been at the General Post Office, St. Martin's-le-Grand. Through that trial they had obtained an order for six small arc lamps. They were now testing lamps to send to Berlin to the Edison Company of Germany, who, he hoped, might feel disposed to purchase the patent for that country. Trials of the lamp had also been made at Vienna and Paris by the Imperial Continental Gas Association. Much satisfaction had been expressed by those who witnessed the trial at the works of the Gülcher Company, who had made a proposal, on certain terms, to purchase the lamp. The directors, however, had not thought the offer sufficiently good, so the matter had been dropped for the time being. They had obtained permission to instal five arc lamps at the Liverpool Street station of the Great Eastern Railway Company. They had accepted the offer made to them to finish the lighting of the hospitals, on the ships and on shore, belonging to the Metropolitan Asylums Board at Dartford. That work had been successfully accomplished. The directors had done all they could to keep down the expenses. The stock and plant they believed had been taken at a low valuation.

Mr. R. van Zeller seconded the motion.

The Chairman, in reply to Major H. F. G. FitzGerald, said they considered that the lamp could be made for 30s. to 35s., without the globe.

The motion was carried, and the meeting terminated.

Eastern Extension, Australasia and China Telegraph Company, Limited. — This company has declared an *interim* dividend for the quarter ended September 30th last of 2s. 6d. per share, free of income tax, payable on January 15th.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of December was 3,695, estimated to produce £3,100, against 3,023 messages, producing £2,448 in the corresponding month of last year. The receipts for the month of September, estimated at £2,250, realised £2,272.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 31st December are £3,018, as compared with £2,054 in the corresponding period of 1885. The September receipts, estimated at £3,526, realised £3,713.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending December 31st were £2,869 after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Great Northern Telegraph Company, Limited. The receipts for December, 1886, were £19,600; from January 1st to 31st December, 1886, £258,600; in the corresponding months, 1885, £284,720; and of 1884, £276,280.

The Eastern Extension, Australasia and China Telegraph Company, Limited. The receipts for December amounted to £40,539, and in the corresponding period of 1885 to £34,785.

The Eastern Telegraph Company, Limited. The receipts for December, 1886, amounted to £52,825, against £53,179 in the corresponding period of 1885.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts of this company for the week ending December 31st amounted to £3,538.

NEW PATENTS—1886.

17060. "Mechanical telephone apparatus." H. H. LAKE. (Communicated by G. W. Lord and H. E. Townsend.) Dated December 29.

17069. "Submarine incandescence lanterns." J. A. MACLELLAN. Dated December 30.

17084. "Board for mounting telephonic switches and other electrical apparatus, &c." A. R. BENNETT. Dated December 30.

17101. "Making caustic soda or potash or carbonate of sodium or potassium together with sulphuric acid by means of electrolysis." G. KAMENSKY. Dated December 30.

17120. "Dynamo-electric machinery." R. E. B. CROMPTON, J. SWINBURNE. Dated December 31.

17138. "Electrically signalling on railways." E. DELFIEN. Dated December 31.

1887.

37. "Glue electrotyping." J. HUSNIK. Dated January 1.

64. "Conduit for wires conveying electricity." J. A. STIRTON. Dated January 3.

72. "Electric measuring instruments." W. T. GOOLDEN, S. EVERSHED. Dated January 3.

73. "Electrical indicators." A. J. BOULT. (Communicated by J. Ferrer.) Dated January 3.

74. "Electric telegraph and indicator apparatus." R. A. SCOTT. Dated January 3.

111. "Electrolyte and depolarising solution for voltaic batteries." W. C. QUIMBY. Dated January 4. (*Complete.*)

114. "Dynamo-electric and electro-dynamic machines." W. A. LEIPNER. Dated January 4.

148. "Measuring and regulating electric currents." E. DESROZIERS. Dated January 5.

165. "Extracting raffinose, &c., from sugar solutions by means of lead either in the form of oxide or as electrode." C. D. ABEL. (Communicated by Pfeifer and Langen.) Dated January 5. (*Complete.*)

168. "Electric regulators; apparatus therefor." C. L. R. E. MENGES. Dated January 5. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1886.

6845. "A novel process for the manufacture of active electrodes and their application to primary and secondary batteries." P. BAILLY. Dated November 6. 8d. Claims:—1. The use in batteries of electrodes made to lead plates cut into coarse filaments or tapes to act as conductors, which are interwoven with lead wool substantially as described. 2. The use of removable porus receptacles with or without holes, for secondary batteries, so as to avoid the detachment of the active material from the lead plates.

9757. "Improvements in electric meters." S. PITT. (Communicated from abroad by J. J. A. Aubert, of Lausanne.) Dated July 28. 6d. When a current passes an armature is attracted by the electro-magnet, releases the pendulum of a clockwork movement which commences to run, and measures the exact duration of the passage of the current; but when the latter is interrupted the armature being pulled by a spring, and being no longer attracted by the electro-magnet, resumes its original position, and the clock is stopped. Claim:—The construction of a meter for measuring the duration of the passage of an electric current, consisting of the combination of an electro-magnet worked by the current with a clockwork movement substantially as described and shown.

10050. "Improvements in and connected with incandescent electric lamps." P. M. JUSTICE. (Communicated from abroad by A. Cruto, of Italy.) Dated August 5. 8d. Claims:—1. An incandescent electric lamp the top of the carbon of which is prevented from oscillation by means of a hook or connection attached thereto and one end being also sealed in the glass, substantially as described. 2. In the manufacture of incandescent electric lamps in which the carbon is to be prevented from oscillation by means of a hook or connection as described, the process set forth for applying and securing said hook or its equivalent, substantially as described. 3. The process described by which in the manufacture of an incandescent electric lamps an enlargement at the base of the carbon is effected as also a carbon for incandescent electric lamps formed with such an enlargement, substantially as and for the purposes set forth. 4. In an incandescent electric lamp covering the metallic conductors which support the carbon with vitrifiable varnish or colours, enamel or any other substance having similar properties, substantially as and for the purpose set forth.

10097. "Improvements in electrical signalling apparatus for railway purposes." H. H. LAKE. (Communicated from abroad by L. Clémandot, of Paris.) Dated August 6. 8d. 1. In apparatus for automatically signalling the approach of trains, the combination of a relay arranged to close a local circit to operate a signal, with an interrupter having an electro-magnet, the armature of which is adapted to interrupt, in the relay, the passage of the current of a constant battery, the said interrupter being operated by closing a circuit of less resistance than that including its electro-magnet, which closing is effected by the passage of a train. 2. The arrangement of the apparatus in such a manner that one of the two rails is brought into circuit only when the interrupter is operated, thereby simplifying the apparatus, and rendering it less delicate. 3. The improved apparatus, consisting of the parts constructed and combined, substantially as described with reference to the accompanying drawing, and operating as set forth.

10242. "Improvements in and relating to electro-magnetic locks, chiefly designed for safes." H. H. LAKE. (Communicated from abroad by F. Sedgwick, of Chicago.) Dated August 10. 8d. The purpose of the invention is chiefly to provide an electro-magnetic permutation or combination lock so arranged and constructed that the tumblers and bolts in ordinary use may be manipulated thereby from without the safe when the safe door to which the same is attached is closed, and said safe locked or unlocked without the aid of the usual spindle or any direct and positive mechanical connection through the door. The claims are 12 in number.

10536. "A new and useful composition of matter to be used as an electric battery excitant." E. D. KENDALL. Dated August 17. 4d. Consists of a bi-sulphate or bi-sulphates of an alkali or alkalies, or sulphuric acid, or both in combination with chromic acid. The claims are 7 in number.

11099. "Improvements in and connected with electric railways." P. M. JUSTICE. (Communicated from abroad by The United States Electric Company (Incorporated), of America.) Dated August 31. 8d. Consists essentially of a line or lines of insulated wire or similar conductors in connection with a suitable track, said conductors having exposed contact parts between their sections, and operating in connection with a motor and devices for taking the current from the exposed contact points. The claims are 10 in number.

11317. "Improvements in electric call and fire alarms." H. J. HADDAN. Dated September 4. Claims:—1. The combination with the clock mechanism, of a disc actuated thereby, and adapted to rotate in unison with the hour hand of the clock, the battery and the call bells connected in open circuit, the switches to close the said circuits and sound either of the bells, and the switch pins adapted to be inserted in openings in the disc and strike the switches to close the latter as the disc rotates, substantially as described. 2. The combination of a rotating disc having the radial rows of numbered openings corresponding to the hours, the battery and the call bells connected in open circuit, the switches to close the said circuits and sound either of the bells, the switch pins adapted to be inserted in the openings in the disc and close the switches as the disc rotates, and the pointer, substantially as described. 3. The combination of a rotating disc having the radial rows of openings, and the numbered dial to indicate hours, co-incident with the rows of openings, the battery and the call bells connected in open circuit, the switches to close the said circuits and sound either of the bells, the switch pins adapted to be inserted in the openings in the disc and close the circuits as the disc rotates, and the pointer, substantially as described. 4. The combination with the battery, the call bells connected therewith in open circuit, the switches to close the circuits, and the rotating disc having the pins to close the switches, and a switch arm adapted to shunt the bell circuits into connection with the battery simultaneously, whereby all the bells will be sounded at once, for the purpose set forth, substantially as described. 5. In an alarm mechanism of the character described the spring actuated switch levers having the tappet arms in combination with the movable disc having the pins to strike the said arms and operate the switches, substantially as described

11355. "Improvements in and relating to conductors for electrically driven vehicles." O. IMRAY. (Communicated from abroad by W. W. Averell, of America.) Dated September 7. 6d. Claims:—1. For insulating conductors in roadways, the combination with a body of cement, of a conducting rail insulated thereby and imbedded therein, substantially as described. 2. A conductor for electric car motors, consisting of a conducting rail, a non-conducting body of asphaltic concrete in which the rail is imbedded, and an insulated trough or box containing the concrete and serving for the return circuit, substantially as described. 3. For electric conduction for car motors, the combination of a conducting rail embedded in asphaltic concrete, an insulated trough or box containing the concrete, a wheel on the car running on the conducting rail and wheels running on the edges of the trough, these wheels being mounted on spring arms connected to the motor, substantially as described.

11499. "Improvements relating to telephonic apparatus, chiefly designed for transmitting sound vibrations existing in or communicated through the earth." H. H. LAKE. (Communicated from abroad by D. Drawbaugh, of America.) Dated September 9. 6d. Claim:—In combination with an implement adapted to penetrate solid substances, and contained within the same, microphonic electrodes, and circuit connections, substantially as described.

12001. "An auxiliary mouth-piece for telephones." N. A. TANNER. Dated September 21. 6d. Consists in a novel combination of a sound chamber and funnel for focusing the sound waves upon the diaphragm of a telephone transmitter and in a spring clasp for attaching the device to the case of the transmitter. The claims are 2 in number.

CORRESPONDENCE.

Mysteries of Secondary Batteries.

I find that in your issue of December 3rd, 1886, page 550, under the heading, "Mysteries of Secondary Batteries," you quote me as pretending to hold *sulphate of copper* responsible for the vagaries of the secondary battery.

It is true that we of America have a reputation for "ways that are dark and tricks that are vain" in getting at things theoretical or things practical; but I did not expect to find that we were considered so radical, so "advanced" as all that. I confess I was more than surprised to find myself quoted as authority for the preposterous notion that sulphate of copper could be a source of trouble in the storage battery, and it required a copy of the publication in question (*The Transactions of the Am. Inst. E.E.*) to convince me that such expression did occur therein in connection with the storage battery. I cannot even yet believe that the reference made by you could in all seriousness contemplate placing what was so evidently an error, either of tongue or pen, in the light of an "ultra-advanced" idea.

On the previous page (136) of the same publication, in the conclusion of Mr. Bauer's paper on storage batteries, occurs this sentence:—"During discharge sulphate of lead is formed, and that is the destroying agent in secondary batteries." Now that is unquestionably the kind of sulphate I had in my mind, when, in rising to discuss the paper, I spoke the words in which you find "sulphate of copper." That particular sentence begins with the words "*As the paper shows*"—a sufficient indication that I referred to something discussed in the paper of Mr. Bauer. As Mr. Bauer's paper speaks of sulphate of lead, it is easy to understand that I intended to say, and *probably did say*, sulphate of lead. At times, in discussion, I speak very rapidly, and I am, therefore, especially liable to give the stenographer trouble. If space permitted I could amuse your readers with some very choice absurdities which were attributed to me in the stenographic report of a lecture delivered at the first meeting of the A.I.E.E. The lecture had to be omitted from the transactions because the report was worse than useless. I still preserve this report as a specimen of misinformation equal to the primer No. 00 of the Philadelphia Exhibition.

I might mention another error occurring on p. 139, where the last word should read "resistance" instead of "gravity" for evident reasons.

I will encroach further upon your space only to state that by oversight the proofs of this part of the transactions were not submitted to me; that is why these errors have not been corrected.

C. O. Mailloux.

December 20th, 1886.

Electrical Welding.

In view of the claims of Prof. Elihu Thomson and others to the invention or discovery of a process of electrical welding, the following note which I find on page 113 of the "Annual of Scientific Discovery," Boston, 1863, is interesting:—

Welding Iron in Vacuo.—"In a communication to the Academy of Sciences, at Paris, M. Faye has given the following account of some experiments in which M. Ruhmkorff took part. An iron wire was cut in two, and the ends brought into contact without any mechanical pressure; this done, by means of an electrical current the wires were heated to a dark red in vacuo, and they were thus instantaneously welded together. The wires were at an angle of 150°, and yet, with that inclination, they supported a weight of upwards of 3 kilogrammes before breaking at the point where the welding had been effected. The same experiment made in the open air, by way of a counter proof, led to no result. Encouraged by this success, M. Faye heated a thick iron cylinder in vacuo; it had been sawed in two, and the parts then joined together by two screws. The latter having inadvertently been made of brass they began to melt during the heating process, but although but a very small portion of the metal had actually become fluid, it penetrated by capillary attraction, aided by the vacuum, into the smallest fissures, soldering the two pieces with extraordinary nicety."

Geo. H. Benjamin.

December 21st, 1886.

N.B.—It is obvious that if the current had been sufficiently increased the same results would be obtained in the air.

Unexpected Courtesy.

"Government officials," particularly of the class that the general public are coming in contact with every day, have not always the reputation of being courteous or obliging. But there are some decided exceptions. A few weeks ago, being on the point of protecting an electrical invention, I had occasion to make a search at the Patent Office in Southampton Buildings. I was there several hours every day for over a week. Having never been in any place of the kind before, I was at first quite ignorant how to proceed. Having had a little experience with "Government gentlemen" in other quarters, I was somewhat diffident, at first, in asking for information, but when I eventually did so I was surprised at the politeness shown. In fact, I may say that all through my search I was delighted at the courtesy and kindness bestowed on me in every particular, and every official was the same in this respect. I came away, indeed, with quite an altered opinion of "Government officials."

R.

December 30th, 1886.

The Upward Battery.

I hope that by this time many amateurs have thoroughly tried this battery, and may be able to give me their experience and their unbiassed opinion upon its merits. I have burned holes in my pockets with every type of primary battery, but the opinions of the knowing ones were so exceptionally favourable with regard to the "Upward," that I was very suspicious, and thought I would wait until some other fellow—a man like myself, possessing only moderate means, having no men servants, and content to take all the personal trouble of the thing—had confided his soul to it. If any such there be, let him own up and help a brother lunatic with his wisdom. I am now using a large Schanschieff, which is reliable and cleanly, but is, alas, also expensive. If I get an Upward I thought of putting battery, generator and all, in an outhouse thirty yards away from my house. Supposing it sprung a leak, would the gas travel as far as my house along the ground and kill my wife, my babes, and my maids (self of no account)?

The aspirator seems an unnecessary bit of complication. Would not the same end be gained by having the last cell on a lower level, with an escape pipe for the air rising to a higher level than the generator? The cell would always keep full by displacement of the air by the heavier chlorine gas, and would thus draw the gas through the cells.

Battery Maniac.

[We refer our correspondent to page 200 of the REVIEW for August 28th, 1886.—EDS. ELEC. REV.]